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Taming the black swan: CEO with military experience and organizational resilience

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Abstract

In this study, we explore how chief executive officers (CEOs) with military experience affect the pre-shock risk taking of firms and thus their organizational resilience to exogenous shocks. We find that the military experience of a CEO is negatively related to the risk taking of a firm before a shock. Furthermore, we find that these pre-shock features promote organizational resilience to shocks, as firms led by CEOs with military experience are more robust and less vulnerable to shocks and can recover from shocks rapidly. This effect is partially mediated by the pre-shock risk taking of firms. We test our hypotheses in the context of the COVID-19 pandemic using a sample of 1,033 CEOs of Chinese listed firms from 2017 to 2020.

Keywords Organizational resilience · CEO military experience · Pre-shock risk taking · COVID-19 pandemic

> "Bamboo, which bends under the weight of winter snow but stands tall again come springtime."
>
> ——Mitchell, 2013

External events (e.g., terrorist attacks, global financial crises, or the current COVID-19 pandemic) have inevitable devastating effects on organizations. Understanding organizational resilience to such events has long been a central focus of strategy research (Dimitriadis, 2021; Levinthal & March, 1981; Thompson, 1967; Wang et al., 2023). Organizational resilience is an organization's potential ability to

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anticipate, avoid, and adapt to shocks from the external environment (Gunderson & Pritchard, 2002; Lengnick-Hall & Beck, 2005; McCann, 2004; Ortiz-de-Mandojana & Bansal, 2016). Considerable empirical evidence supports the argument that resilient firms are likely to survive a crisis (Dai et al., 2017; Gittell et al., 2006; Markman & Venzin, 2014; Ortiz-de-Mandojana & Bansal, 2016) and obtain high profits (Haveman, 1992).

Accordingly, this topic garnered attention from management scholars (Dimitriadis, 2021; van der Vegt et al., 2015). Previous studies mainly examined firm-level factors such as slack resources, corporate culture, and strategic practices and showed how they affect organizational resilience (DesJardine et al., 2019; Dimitriadis, 2021; George, 2005; Kachaner et al., 2012; Ortiz-de-Mandojana & Bansal, 2016). Although a few recent studies enhanced our understanding of the antecedents of organizational resilience at the chief executive officer (CEO) level (Buyl et al., 2019; Sajko et al., 2020), this line of research has focused primarily on the psychological traits of CEOs, with less attention to the CEO experiences which may shape their preferences and ways of thinking (Benmelech & Frydman, 2015; Sunder et al., 2017). This gap in the literature is important, as an individual's decisions and behaviors are influenced by not only who he/she is but also his/her experience (Li et al., 2022; Morgeson et al., 2015). However, relatively little attention was paid to the experiential factors associated with top corporate executives, specifically, the experiences of CEOs, who may facilitate the successful pursuit of organizational resilience.

This study represents an empirical investigation of the relationship between the personal experiences of top managers, specifically, CEOs, and organizational resilience. Specifically, we argue that a CEO's military experience may be an important factor in the successful pursuit of organizational resilience, as military service may alter the behavior of servicemen and servicewomen and further affect their decisions when they become a top executive (Benmelech & Frydman, 2015; Luo et al., 2017). We highlight CEOs' military experience as relevant to organizational resilience, which implies a CEO's ability to help his/her firm demonstrate flexibility and robustness to shocks.

In developing our argument, we draw on upper echelons theory and a specific stream of research (Benmelech & Frydman, 2015; Dai & Liu, 2009; Giannetti et al., 2015; Guo et al., 2020) suggesting that CEOs' prior experiences can indirectly influence organizational outcomes through the activities and behaviors they engaged in after becoming a CEO, which in turn will have an impact on organizational outcomes. In our study, we focus on firms' pre-shock risk taking, because firms' resource allocation to risky behaviors can have an important impact on their stability and flexibility after a shock.

We test our ideas empirically in the context of the COVID-19 pandemic using a sample of Chinese firms listed on either the Shenzhen or Shanghai Stock Exchange between 2017 and 2020. The COVID-19 pandemic is unprecedented in its complexity and severity (Gormsen & Koijen, 2020). After the Wuhan lockdown on January 23, the stock market's reaction to the pandemic strengthened (see Fig. 1). Such aspects make the COVID-19 pandemic in China an ideal natural setting in which to examine organizational resilience. The main results show that CEOs with military

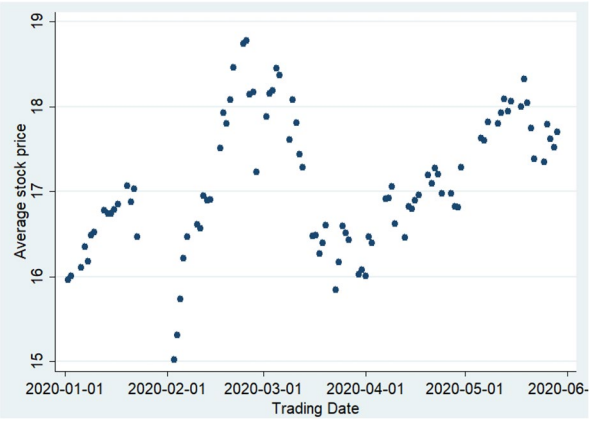

Fig. 1 Average daily stock price during the period from January to June 2020

experience are less likely to engage in pre-shock risk taking. We also find that a low level of pre-shock risk taking is associated with a high level of organizational resilience. Furthermore, we determine that pre-shock risk taking partially mediates the effect of CEOs' military experience on organizational resilience.

Our study has several contributions. **First,** we contribute to the literature on the antecedents of organizational resilience by providing additional empirical evidence showing that top managers' prior experiences, specifically, military experience, may play an important role in the successful pursuit of organizational resilience. **Second**, we contribute to the military leadership literature by linking CEOs' military experience with organizational resilience in the context of the COVID-19 pandemic. Unlike nearly all previous studies, which focused on how CEOs' military experience affects firms' decisions during normal times, our study highlights the crucial role of CEOs' military experience in helping firms build resilience in the context of exogenous shocks. **Third**, we contribute to upper echelons theory and strategic leadership by opening the black box of the relationship between CEOs' military experience and organizational resilience through firms' pre-shock risk taking.

Theoretical background

Organizational resilience

The literature on resilience commonly identified two different dimensions, namely, stability and flexibility (DesJardine et al., 2019; Sajko et al., 2020). Stability refers to a firm's ability to maintain its key organizational attributes, such as core functions and structure, in the face of disruptions (Weick et al., 2008). Meanwhile, flexibility refers to a system's capacity to bounce back, which requires abundant flexible and diverse resources that can facilitate the development of alternative solutions for the same disruptions (Sanchez, 1995; van der Vegt et al., 2015). From this perspective, organizational resilience refers to a system's potential ability to endure adversity, recover, and maintain its existing structure after a shock (Gunderson & Pritchard,

2002). Scholars found that organizational resilience has key strategic importance to firms, because it can help them survive by improving their ability to endure and adapt to environmental changes (Gittell et al., 2006; Markman & Venzin, 2014; Ortiz-de-Mandojana & Bansal, 2016). Effective response and recovery processes are crucial to handling disruptive events and saving a firm's "life" (van der Vegt et al., 2015).

Despite its advantages, achieving organizational resilience may be difficult for firms. The building of organizational resilience often requires managers' commitment. Specifically, managers must take responsibility for building a resilience-focused culture, deploying resources to promote employee engagement and training, and establishing technical measures to anticipate and respond to adversity (Labaka et al., 2016). Such responsibilities will require managers to balance their allocation of attention and resources between activities supporting the firm's existing operations and those supporting future resilience preparations. However, scholars found that potential barriers to organizational resilience are related to managers' perception that resilience results in few or no benefits for the organization, high corresponding administrative costs, and additional bureaucratic processes (Halkos et al., 2018).

Previous research identified several factors related to the achievement of organizational resilience. Much of such work highlighted the importance of firm-level factors such as social networks, organizational culture, and resources. For example, Gittell and scholars (2006) investigated the recovery of the US airline industry after the terrorist attacks of September 11, 2001, and found that social networks have a positive impact on the improvement of organizational resilience. Ortiz-de-Mandojana and Bansal (2016) argued that the social and environmental practices associated with business sustainability can contribute to firms' long-term organizational resilience. Dimitriadis (2021) determined that social capital can have a contradictory influence on entrepreneurs' resilience depending on the type of relationships they formed and how the relationships are exposed to a shock.

Meanwhile, other studies focused on the impact of individual-level factors on organizational resilience, which generally hold the view that a critical source of organizational resilience is employees' characteristics. For example, Lengnick-Hall et al. (2011) proposed that organizational resilience can be developed by managing human resources to improve employees' competencies, which is aggregated at the organizational level and can strengthen an organization's resilience capacity when experiencing a shock. Other studies emphasized the impact of specific human resource management practices, such as employee training, on organizational resilience (Andersson et al., 2019; Karman, 2020).

While much of the extant research on organizational resilience focused on identifying firm-level and employee-level factors, nearly all studies ignored top executives' individual characteristics, except a few that investigated the relationship between CEOs' psychological traits and firm resilience (Buyl et al., 2019; Sajko et al., 2020). Recent works suggested that individual experience-related factors may also play a role (O'Sullivan et al., 2021; Chahyadi et al., 2021; Guo et al., 2020). This emerging stream of research is relevant, because individuals' decisions and behaviors are influenced by not only who they are but also their experiences (Li

et al., 2022; Morgeson et al., 2015). Prior works suggested that to achieve and manage organizational resilience, leaders must prepare their firms based on their experiences to act in ways that will enable them to endure and survive extraordinary hardships (Coutu, 2002).

We examine this emerging work that links executives' experiences to organizational resilience by paying attention to CEOs' military experience. We argue that a top executive's military experience may be a relevant differentiating factor enabling a firm to achieve and manage resilience. We consider CEOs as the top executive managers of interest, because CEOs are the most crucial decision makers in a company and typically responsible for the allocation of corporate resources between existing operations and future resilience preparation activities (Marcel et al., 2011).

CEO s' military experience

Serving in the military may change the behaviors of servicemen and women in a variety of ways, which may persist despite significant environmental changes after their service (Malmendier et al., 2011; Luo et al., 2017; Koch-Bayram & Wernicke, 2018). Of particular relevance to resilience management, and based on evidence from sociology and organizational behavior research, individuals may gain hands-on leadership experience through military service, which may be difficult to learn by other means, and become adept at making decisions under pressure or during a crisis (Duffy, 2006).

Previous research linked executives' military experience to several firm behaviors. For example, individuals with military experience were found to be less likely to engage in unethical behavior in their firm; for example, the firm they managed was less likely to engage in tax avoidance, be a target in class action lawsuits, and announce financial restatements (Law & Mills, 2017; Luo et al., 2017). Furthermore, researchers found that executives with military experience are conservative in their management style (Bamber et al., 2010), corporate tax planning and financial decisions (Benmelech & Frydman, 2015), and fraudulent financial reporting (Koch-Bayram & Wernicke, 2018). This tendency to be conservative or uncertainty averse can also lead to low levels of R&D investment and indebtedness in firms with military-experienced executives (Benmelech & Frydman, 2015).

In summary, the findings of research on executives' military experience suggested that such an experience may have an important influence on risk behaviors related to organizational resilience. Research on organizational activities from the risk-taking perspective (Bernile et al., 2017; Hoskisson et al., 2017) suggested that the CEO, as the chief risk-taking decision maker of an organization, makes decisions on the existence of risk-taking strategies in the organization. In addition, a company's resilience is related to its pre-shock risk-taking strategy choices (Kantur & Iseri-Say, 2012; Mallak, 1998). This finding suggests that one mechanism through which CEOs' military experience influences organizational resilience is firms' risk-taking activities before the shock. Thus, we review firms' pre-shock risk taking, which is relevant in the context of organizational resilience.

Resilience and firms' risk taking

Risk taking reflects a firm's willingness and propensity to pursue and pay for high profits and is expressed in the firm's choice of risky investment projects (Acharya et al., 2011; Boubakri et al., 2013), such as R&D expenditure, tax planning, financial restatement, earnings management, and mergers and acquisitions. However, such risky projects typically require a large amount of fixed investments, such as high capital expenditures and large R&D investments, which can lock in and exhaust a firm's internal resources (Bargeron et al., 2010; Hilary & Hui, 2009).

Studies found that the consumption of slack resources as a result of high-level risk-taking strategies may be associated with the resilience of firms under stress or in crisis (Dimitriadis, 2021; Sutcliffe & Vogus, 2003). Specifically, slack resources, which are bound to be affected by a firm's risk taking before a shock, play an important role in determining whether a firm can recover from and build resilience to a shock (Kantur & Iseri-Say, 2012; Mallak, 1998). In addition, slack resources refer to a firm's financial reserves, debts, cash, and excess capacity during growth periods, which can be used to maintain its performance during shock periods (George, 2005).

In terms of the stability dimension of resilience, slack resources buffer firms during disruptions and enable them to wait out a crisis (Voss et al., 2008). With regard to the flexibility dimension of resilience, slack resources can increase firms' flexibility and time to initiate strategic changes (Bourgeois, 1981). Moreover, firms with sufficient and available resources are likely to survive, maintain their operations, and take advantage of new opportunities during shock periods (Kantur & Iseri-Say, 2012; Mallak, 1998). Taken together, the above concepts suggest that firms' pre-shock risk-taking activities, specifically, their consumption of slack resources, have important implications for their stability and flexibility and thus capacity to build organizational resilience.

In summary, our study links CEOs' military experience with firms' pre-shock risk taking and organizational resilience and is based on the assumption that CEOs' prior experiences can indirectly influence firms' outcomes through activities and behaviors they undertaken. In the next section, we will explore more specific linkages among the components of our framework.

Hypotheses

CEOs with military experience and organizational resilience

Literature on resilience commonly identifies that, compared with others, resilient organizations are better able (a) to preserve their core structures and (b) to bounce back from setbacks because they excel at anticipating, absorbing, and adjusting to environmental changes (Ortiz-de-Mandojana & Bansal, 2016). In this line, we

separately explore the impacts of CEOs' military experience on two dimensions of organizational resilience: stability and flexibility.

Stability Benmelech and Frydman (2015) have found that organizations with military CEOs perform better during industry downturns. The authors attributed this result to the personal characteristics of CEOs with military experience who prefer cautious and conservative corporate policies. Similarly, military men are believed to perform better due to a greater sense of commitment. Given their high degree of risk aversion, CEOs with military experience are more likely to carefully monitor and sufficiently prepare for potential threats (Franke, 2001).

All the above points imply that contextual conditions, such as systemic shocks in the environment, may have less impact on firms run by CEOs with military experience. Given their high level of caution and risk aversion, CEOs with military experience improve their firms' ability to predict and adjust to problems. Hence, we hypothesize that:

Hypothesis 1a CEO military experience is positively associated with the firm stability following a shock.

Flexibility Resilience literature emphasizes that the pre-shock characteristics of firms not only affect their stability to shocks, but also their flexibility (Buyl et al., 2019; Desjardine et al., 2019; Sajko et al., 2020). In particular, the pre-shock strategies and investments that lock in and exhaust organizations resources limit the firm's flexibility to restructure these resources (Sutcliffe & Vogus, 2003). However, a sufficient amount of internal resources and the ability to rearrange, which transform and adjust them to adapt to uncertain conditions, are crucial in enhancing the flexibility of firms after a shock (Bayazitova & Shivdasani, 2012; Buyl et al., 2019; Sutcliffe & Vogus, 2003). Accordingly, CEOs with military experience may impact the recovery of stock prices after the shock due to the following reasons:

First, individuals with military experience tend to have a strong sense of responsibility and a high degree of discipline and loyalty to the organization (Law & Mills, 2017). CEOs with military experience often do not pursue short-term benefits by sacrificing long-term firm performance. Military CEOs tend not to abuse resources to obtain individual benefits, and thus the firms may have more internal resources to recover after the shock.
Second, military experience is more likely to induce individuals' conservative and cautious behavioral tendencies, especially in the face of risky decisions that require considerable resources (Benmelech & Frydman, 2015; Duffy, 2006; Guo et al., 2020). CEOs with military experience tend to be more risk averse, which provides more resources for corporate recovery. Once the shock has occurred, firms can use these sufficient internal resources to achieve recovery afterwards. Hence, we propose:

Hypothesis 1b CEO military experience is positively associated with the firm flexibility following a shock.

CEOs' military experience and firms' pre-shock risk taking

Upper echelons theory suggests that firms' strategic choices are strongly influenced by executives' personality and values (Hambrick & Mason, 1984). Unique personal background experience, such as educational, functional, and other types of experiences, can serve as a proxy for CEOs' personality or values and provide a filter for their interpretations of the organization and environment, which in turn can affect their decisions (Benmelech & Frydman, 2015; Hambrick & Mason, 1984; Malmendier et al., 2011). Risk-taking decisions are among those decisions which are affected by a CEO's personal experiences (Bernile et al., 2017; Campbell et al., 2019; Kish-Gephart & Campbell, 2015; Sunder et al., 2017). Hence, we expect CEOs with military experience can negatively related to their firm's pre-shock risk taking for three reasons.

First, the strict discipline and obedience to orders in the military service mean the avoidance of risk behaviors, which makes CEOs with military experience prefer conservative business decision-making in daily management (Duffy, 2006). To avoid operational risks, CEOs with military experience usually pay more attention when making risky decisions. Benmelech and Frydman (2015) have found that CEOs with military experience make lower corporate investment decisions and pursue more conservative financial and investment policies.

Second, military service has always emphasized the clarity of strategic objectives, which makes soldiers form behavioral characteristics of avoiding uncertainty (Guo et al., 2020). CEOs with military experience prefer more predictable decision results, and thus are more likely to be cautious when making risky decisions. For example, when CEOs with military background make risky corporate decisions such as long-term R&D investment, they tend to be more cautious because of the long incubation period and high uncertainty of results.

Third, military service often emphasizes a stricter moral code and self-sacrifice, CEOs with military experience are thus more restrained in their corporate decision-making rather than pursue self-interests through short-term investments with high risks (Franke, 2001; Wansink et al., 2008). In fact, actions that are considered unethical or illegitimate are often less observed on military top executives (Luo et al., 2017).

In summarize, we argue that the risk-averse, uncertainty-averse, and self-sacrifice personalities and values, which they developed during their military service, carry over to their post-military life and subsequent job positions. CEOs are actively or passively involved in deciding whether to engage in risk taking in the day-to-day operations of their firm, in which they use their personal value system. We propose that the risk-averse, uncertainty-averse, and self-sacrificing characteristics reflected by CEOs with military experiences will lead them to engage in less risky strategies. Hence, we propose the following hypothesis:

Hypothesis 2 CEOs with military experience are less likely to engage in firms' pre-shock risk taking.

Firms' pre-shock risk taking and organizational resilience

We suggest that there is a negative relationship between pre-shock risk taking and organizational resilience. From the perspective of resources, organizational resilience depends on the existence and deployment of firm resources under stress or in crisis (Dimitriadis, 2021; Sutcliffe & Vogus, 2003). Sufficient and available resources in corporate decision-making play an important role in determining whether a firm can recover and build resilience to a shock (Kantur & Iseri-Say, 2012; Mallak, 1998), but are bound to be affected by firms' risk taking before the shock.

Stability We propose that the level of firms' pre-shock risk taking affects the stability of firms in the shock period. Specifically, a high level of risk-taking strategies means that firms are more likely to engage in risky projects (Acharya et al., 2011; Boubakri et al., 2013), such as R&D expenditure, tax planning, financial restatement, earning management, and merger and acquisition (M&A). Large investments in such risky projects are generally associated with higher earnings volatility, which may make the firms unable to cover its fixed costs when revenues decline (Li & Marinc, 2014). For example, Pablo et al. (1996) have found that too many investments of internal resource into M&A may lead to problems in internal capital and increase the financial risk of the firm. In this case, investing more on risky projects intensified the firms' vulnerability to sharp declines in revenues and capital accessibility.

Flexibility We propose that firms' high level of risk taking before the shock not only leads to less stability but also fosters less flexibility after the shock. Specifically, sufficient resource reserve and high level of resource availability are important factors that affect whether a firm can adapt to the systemic shock in the environment and then rapidly recover (Bayazitova & Shivdasani, 2012; Buyl et al., 2019; Sutcliffe & Vogus, 2003). Firms' risky projects often include a large amount of fixed investments associated with high risk, which are often referred to long-term investment, such as high capital expenditure and large R&D investment (Bargeron et al., 2010; Hilary & Hui, 2009). Given these fixed investments, pre-shock risk taking locks in and exhausts internal resources, thus restraining firm flexibility after the shock (Apergis, 2014). Therefore, we expect that firms with high level of pre-shock risk taking take more time to recover from exogenous shocks. Hence, we posit that:

Hypothesis 3a Firms' pre-shock risk taking is negatively associated with the firm stability following a shock.

Hypothesis 3b Firms' pre-shock risk taking is negatively associated with the firm flexibility following a shock.

Mediating effects of firms' pre-shock risk taking

We next argue that the impact of CEOs' military experience on organizational resilience is mediated by their firms' risk-taking activities before a shock. Our argument is based on the premise that CEOs' prior experiences can indirectly affect organizational outcomes through the activities and behaviors they engaged in after becoming a CEO (Benmelech & Frydman, 2015; Dai & Liu, 2009; Giannetti et al., 2015; Guo et al., 2020). Therefore, we argue that CEOs with military experience are less likely to engage in their firm's risk taking in its day-to-day operations. In this way, firms managed by CEOs with military experience are likely to have sufficient and available resources for withstanding and recovering from crises. Hence, we propose the following hypothesis:

Hypothesis 4 Firms' pre-shock risk taking mediates the relationship between CEOs' military experience and firms' resilience (stability and flexibility) following a shock.

Methods

Context and sample

The COVID-19 pandemic is unprecedented in its complexity and severity. After the Wuhan lockdown on January 23, the stock market's reaction to the pandemic strengthened (Gormsen & Koijen, 2020). Such aspects make the COVID-19 pandemic an ideal natural setting in which to examine organizational resilience. In this study, we identify January 23, 2020, as the time the systemic shock occurred.

The sample comprises all the Chinese firms listed on either the Shenzhen or Shanghai Stock Exchange between 2017 and 2020. We collect the data from several sources, including the China Stock Market and Accounting Research database, Wind database, and firms' annual reports and website. We exclude firms in the financial industry from the sample. The selected firms are required to have complete information and top executives' information in their financial statements.

In addition, according to previous studies (Boubakri et al., 2011; Chin et al., 2013; Faccio et al., 2011), the tenure of senior executives of Chinese listed companies is generally three years; thus, we set the observation period to every three years to investigate the managers' tenure and calculate the firms' pre-shock risk-taking level. Hence, we require the CEOs in the sample to be observed for three consecutive years, that is, 2017, 2018, and 2019, and working in the company before the Wuhan lockdown on January 23. Furthermore, we manually search multiple data sources for information on the CEOs' military experience. Our sources include company websites, annual reports, company prospectuses, company media releases, and CEOs' biographical information on news websites (e.g., Baidu, Sina Finance, and Hexun). Using the sources, we obtain a sample of 1,033 CEOs working in the Chinese firms listed between 2017 and 2020.

Measurement

Dependent variables The dependent variables measure two outcomes of organizational resilience based on stock price data, that is, severity of loss (stability) and time to recovery (flexibility). It is important to note that our focus is not on measuring stock prices themselves; rather, we aim to measure the extent and speed of their decline and subsequent rise to pre-COVID-19 levels. This approach is intended to reflect the concept of firms' resilience, defined as the capacity to recover from adversity (Gittell et al., 2006).

Stability Following DesJardine et al. (2019) and Sajko et al. (2020), we measure the drop in a firm's stock price as the absolute percentage change between the closing price before the start of the Wuhan lockdown on January 23, 2020 and lowest closing price of the stock within a four-month period. For this measure, a high value reflects a large drop. In addition, a visual inspection of the average daily stock price movements confirms that after the occurrence of the economic shock caused by the pandemic, the largest drop in the stock price of the listed firms occurred in early February. Considering that firms may receive policy support from the government in a bankruptcy crisis, our study focuses on the immediate impact of the pandemic in the short term (four-month period), during which the Chinese stock market was predominantly influenced by the pandemic rather than other policy factors.

Flexibility Following DesJardine et al. (2019) and Sajko et al. (2020), we calculate the time it took for the firms' stock price to fully recover and return to pre-shock (i.e., January 22, 2020) levels after the onset of the pandemic. The dependent variable is the hazard rate, which represents the probability of a firm to recover at time t (Cox, 1972; Cox, 1992). In our sample, 894 firms reached their pre-shock price at least once before May 29.

Independent variable: Military CEO Following previous studies, we use CEOs with military experience as dummies, which take a value of 1, and 0 otherwise (Benmelech & Frydman, 2015; Luo et al., 2017; Koch-Bayram & Wernicke, 2018).

Mediating variable: Firms' pre-shock risk taking Consistent with previous studies (Boubakri et al., 2011; Faccio et al., 2011; John et al., 2008), the primary measure of the firms' risk taking before the pandemic is the volatility of profitability. The specific calculation method is as follows:

$$RiskTaking_{it} = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}\left(AdjROA_{ijt} - \frac{1}{T}\sum_{t=1}^{T}AdjROA_{ijt}\right)^2} \;|T = 3$$

$$AdjROA_{ijt} = \frac{EBIT_{ijt}}{Asset_{ijt}} - \frac{1}{njt}\left(\sum_{k=1}^{n_{jt}}\frac{EBIT_{ijt}}{Asset_{ijt}}\right)$$

where *AdjROA* is the year- and industry-adjusted return on assets; *Asset* is the average total asset;*i*, *j*, and *t* represent the firm, industry, and year respectively; n_{jt} indexes the firms in industry *j* and in year *t*; and $T = 3$ represents the three overlapping periods before the shock.

Control variables We include control variables at different levels of the analysis. At the firm level, we control for firm size, LEV, ROA, growth, PPE, CAP, slack resources, state ownership, environmental dynamism, and environmental munificence. Furthermore, we control for the firms' list age, ownership, independent directors, CEO duality, CEO compensation, and female directors. At the CEO level, we control for CEO gender, CEO age, CEO tenure, CEO education. Additionally, we control for two firm-level factors that may have affected the drop in the firms' stock price immediately after the shock, namely, operational efficiency and capital intensity. We also control for the firms' stock price before the shock, which we measure as the closing price on January 22, 2020, and industry and year dummies. We use the industry dummy according to the 13 industry categories identified by the China Securities Regulatory Commission. Table 1 summarizes the variable descriptions.

Analytical techniques

The following regression models are used to test the influence of the CEOs with military experience on organizational resilience and the mediating effect of the firms' risk taking before the shock.

First, Eqs. (1) and (2) are used to test the relationship between CEOs with military experience and organizational resilience (Hypotheses 1a and 1b)

$$Stability = \beta_0 + \beta_1 MilitaryCEO + \sum Control + \sum Industry + \varepsilon \tag{1}$$

$$h(t) = h_0(t)exp\left\{\beta_1 MilitaryCEO + \sum Control + \sum Industry + \varepsilon\right\} \tag{2}$$

Second, Eq. (3) is used to test the effect of the CEOs with military experience on the firms' pre-shock risk taking (Hypothesis 2)

$$Risktaking = \beta_0 + \beta_1 MilitaryCEO + \sum Control + \sum Industry + \sum Year + \varepsilon \tag{3}$$

Third, Eqs. (4) and (5) are used to test the relationship between the firms' pre-shock risk taking and organizational resilience (Hypotheses 3a and 3b):

$$Stability = \beta_0 + \beta_1 Risktaking + \sum Control + \sum Industry + \varepsilon \tag{4}$$

$$h(t) = h_0(t)exp\left\{\beta_1 Risktaking + \sum Control + \sum Industry + \varepsilon\right\} \tag{5}$$

Finally, Eqs. (6) and (7) test the mediating effect of the firms' pre-shock risk taking (Hypothesis 4):

Table 1 Definition of variables

Variables	Description
Military CEO	1 if the CEO has military background, and 0 otherwise
Pre-shock Risk taking	$RiskTaking_{it} = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}\left(AdjROA_{ijt} - \frac{1}{T}\sum_{t=1}^{T}AdjROA_{ijt}\right)^2} \mid T = 3$
Stability	the severity of loss
Flexibility	the time to recovery (hazard rate)
Size	the natural logarithm of year-end total assets
LEV	the ratio of year-end total liabilities to total assets
ROA	the ratio of corporate profits to total assets
Growth	Growth in sales
PPE	the ratio of fixed assets to total assets
CAP	the natural logarithm of cash paid by firms for the fixed assets, intangible assets and other long-term assets
Slack resources	the total cash flow from a firm's operations, financing, and investing activities scaled by its total assets
List age	the logarithm of the number of years since a firm was listed
Ownership	The sum of the shareholding ratios of the top 5 shareholders
Independent directors	the proportion of independent directors in the board
CEO duality	equals to 1 for firms with CEOs who are also serving as board chairmen and equals to 0 otherwise
CEO compensation	the natural logarithm of CEO compensation
Female directors	the ratio of female directors to all directors
CEO gender	equals 1 if the CEO is male and 0 otherwise
CEO age	Age of CEO
CEO tenure	the number of years that the CEO was in his or her position
CEO education	6 = doctoral degree or above,5 = graduate degree, 4 = bachelor's degree, 3 = junior college, 2 = high school, and 1= middle school or below
Operational efficiency	the ratio of sales to total assets
Capital intensity	the ratio of capital expenditures to total assets
Pre-shock stock price	closing price on January 22, 2020
Environmental dynamism	Environmental dynamism was measured according to the volatility of industry sales across time, using a regression analysis with a variable for each year and a variable for industry sales. Five years of data were used for each equation. Following the equation $y = \beta_0 + \beta_1 t + \mathcal{E}$, where y is the industry sales, t is the year and ε is the residual, the volatility of industry sales across time is the standard error of the regression slope coefficient (β_1) divided by the mean value of the dependent variable
Environmental munificence	Environmental munificence was measured using the same regression model, where munificence is the regression slope coefficient (β_0) divided by the mean value of the dependent variable
State ownership	equals 1 if the government controls the company and 0 if not

$$Stability = \beta_0 + \beta_1 MilitaryCEO + \beta_2 Risktaking + \sum Control + \sum Industry + \varepsilon \tag{6}$$

$$h(t) = h_0(t)exp\left\{ \beta_1 MilitaryCEO + \beta_2 Risktaking + \sum Control + \sum Industry + \varepsilon \right\} \tag{7}$$

where Stability reflects the degree of decline in the stock price of the listed firms after the occurrence of the shock; $h(t)$ is the hazard function at time t, which reflects the likelihood of a firm's stock price to recover from the shock; and ε is an error term.

Results

Tables 2 and 3 report the descriptive statistics and correlation matrix of the variables. To address the potential multicollinearity, we checked the variance inflation factor (VIF) of the full models, all of which are well below the cutoff of 10 (Ryan, 1997; Neter et al., 1996). Therefore, multicollinearity is not an important issue in this study.

We test the first three sets of hypotheses using the hierarchical regression approach and the last hypothesis using mediation analysis techniques. Table 4 shows the relationship between CEOs with military experience and firm resilience. Models 1 and 3 serve as baselines that only include control variables. The key independent variable, Military CEO, is added in Models 2 and 4. Specifically, in Model 2, the coefficient of Military CEO is negative ($\beta = -.039$, $p<.05$), thereby suggesting that CEO military experience has a strong negative effect on drop in stock price following a shock. By contrast, in Model 4 of Table 5, the coefficient of Military CEO is positive ($\beta = .811$, $p < .01$), which suggests that firms with military CEOs are significantly more likely to rapidly recover. The results suggest that CEOs with military experience have a positive effect on firm resilience, thereby supporting Hypotheses 1a and 1b.

Table 5 shows the relationship between CEOs with military experience and firms' pre-shock risk taking. Model 1 includes only the control variables. In Model 2, the coefficient of Military CEO is negative ($\beta = -.014$, $p < .01$), suggesting that CEOs' military experience has a strong negative effect on firms' risk taking before the shock. Hypothesis 2 is thus supported.

Table 6 shows the relationship between firms' pre-shock risk taking and firm resilience. In Model 2, the coefficient of firms' pre-shock risk taking is positive ($\beta = .108$, $p < .10$), suggesting that firms' pre-shock risk taking has a strong positive influence on the drop in stock price immediately after the shock. In Model 4, the coefficient of firms' pre-shock risk taking is negative ($\beta = -1.993$, $p < .05$), suggesting that firms with a high level of pre-shock risk taking are significantly more likely to slowly recover. Overall, Hypotheses 3a and 3b are supported, that firms' pre-shock risk taking has a negative effect on firm resilience.

We tested the mediation hypotheses by using the three requirements outlined by Baron and Kenny (1986). In terms of firm stability, (1) we establish the existence of

Table 2 Correlations for the variables (Stability)

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Stability	.20	.08	1											
2. Military CEO	.01	.12	−.07	1										
3. Pre-shock risk taking	.05	.06	.15	−.06	1									
4. LEV	.41	.18	.06	−.03	.03	1								
5. Size	22.39	1.16	.01	−.01	−.09	.50	1							
6 List age	2.53	.48	−.07	−.06	.03	.24	.32	1						
7. Growth	.20	.29	.06	−.03	.07	.06	.05	−.03	1					
8. CEO duality	1.68	.45	−.05	−.01	.02	.08	.12	.20	−.04	1				
9. Independent directors	.38	.05	−.00	−.03	−.00	.03	−.01	−.04	−.00	−.16	1			
10. Female directors	.17	.12	.01	−.00	.04	−.10	−.15	−.14	−.00	−.13	.04	1		
11. Slack resources	2.29	1.98	−.04	.09	−.02	−.66	−.35	−.18	−.05	−.08	−.01	.07	1	
12. ROA	.03	.07	−.11	−.00	−.37	−.26	.11	−.01	.12	.02	−.08	−.03	.16	1
13. PPE	.20	.14	−.05	−.02	.02	.00	.06	.08	−.06	.13	−.06	−.05	−.23	.06
14. CAP	18.69	1.67	.02	.03	−.10	.26	.70	.05	.06	.05	−.04	−.10	−.32	.20
15. Ownership	.62	.29	−.03	−.01	−.08	.05	.17	−.20	.05	.03	.03	−.04	−.02	.16
16. CEO gender	.93	.26	−.07	.03	−.00	−.03	−.03	.01	−.01	.00	−.12	−.22	.03	.01
17. CEO age	51.29	6.20	−.07	.06	−.10	.04	.11	.08	−.04	−.16	−.00	−.04	−.01	.08
18. CEO compensation	13.52	.80	−.04	.00	−.01	.09	.33	.10	.01	.08	−.03	−.01	−.07	.20
19. CEO tenure	6.71	3.55	−.05	.01	−.06	.01	.08	.28	−.10	−.14	−.02	.04	.00	.03
20.Operational efficiency	.59	.37	−.05	−.03	−.07	.17	.05	.02	.06	.05	−.06	−.02	−.17	.18
21.Capital intensity	.04	.03	.05	.05	−.02	−.01	.06	−.21	.07	−.04	.03	.03	−.14	.15
22. Pre-crisis stock price	12.79	13.33	.11	−.02	−.06	−.12	.09	−.17	.15	−.13	−.01	.00	.12	.36
23. Environmental dynamism	.05	.04	.17	−.01	.30	.07	−.05	.09	.49	−.00	.04	−.01	−.00	−.21
24. Environmental munificence	.14	.14	.06	−.02	−.03	.05	.13	−.15	.80	−.09	−.03	.03	−.07	.27

Table 2 (continued)

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
25. State ownership	.27	.44	−.12	−.00	−.11	.20	.30	.45	−.04	.28	−.03	−.24	−.14	.04

Variables	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Stability													
2. Military CEO													
3. Pre-shock risk taking													
4. LEV													
5. Size													
6 List age													
7. Growth													
8. CEO duality													
9. Independent directors													
10. Female directors													
11. Slack resources													
12. ROA													
13. PPE	1												
14. CAP	.36	1											
15. Ownership	.09	.15	1										
16. CEO gender	.05	.03	−.00	1									
17. CEO age	.08	.11	.06	.06	1								
18. CEO compensation	−.01	.24	.03	−.00	.07	1							
19. CEO tenure	.03	.02	−.17	.03	.27	.09	1						
20.Operational efficiency	.03	.08	.05	.02	−.04	.12	−.01	1					
21.Capital intensity	.41	.62	.06	.05	.01	.05	−.04	−.01	1				
22. Pre-crisis stock price	−.09	.16	.13	−.02	.01	.21	−.02	.11	.13	1			
23. Environmental dynamism	−.14	−.17	−.07	−.01	−.10	−.06	−.11	−.18	−.08	−.07	1		
24. Environmental munificence	−.05	.22	.06	−.01	−.05	.06	−.08	.14	.16	.25	.17	1	
25. State ownership	.16	.14	.14	.06	.09	.04	−.05	.04	−.08	−.03	−.04	−.11	1

Correlations≥|.01| are significant at $p \leq .05$. $N = 1033$

Table 3 Correlations for the variables (Flexibility)

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Flexibility	.85	.36	1											
2. Military CEO	.01	.12	.05	1										
3. Pre-shock risk taking	.05	.11	−.05	−.04	1									
4. LEV	.41	.18	−.14	−.03	.02	1								
5. Size	22.39	1.15	−.18	−.01	−.11	.50	1							
6. List age	2.53	.48	−.12	−.03	−.03	.24	.32	1						
7. Growth	.20	.29	−.00	−.02	.01	.06	.05	−.03	1					
8. CEO duality	1.68	.45	−.07	−.00	−.01	.08	.12	.20	−.05	1				
9. Independent directors	.38	.05	−.00	−.05	−.01	.03	−.01	−.04	−.00	−.16	1			
10. Female directors	.17	.12	.08	.03	.06	−.10	−.15	−.14	−.00	−.13	.04	1		
11. Slack resources	2.30	1.98	.12	.08	.01	−.66	−.35	−.18	−.05	−.08	−.01	.07	1	
12. ROA	.03	.06	.06	.01	−.53	−.26	.12	−.01	.12	.02	−.08	−.03	.16	1
13. PPE	.20	.14	−.04	−.01	−.04	.00	.06	.08	−.06	.13	−.05	−.05	−.23	.06
14. CAP	18.69	1.67	−.07	.03	−.13	.26	.70	.05	.06	.05	−.04	−.10	−.32	.20
15. Ownership	.62	.29	−.08	−.04	−.11	.05	.17	−.20	.05	.03	.03	−.04	−.02	.16
16. CEO gender	.93	.26	.03	.03	−.01	−.03	−.03	.01	−.01	.00	−.12	−.22	.03	.01
17. CEO age	51.29	6.20	−.07	.06	−.09	.04	.11	.08	−.04	−.16	−.00	−.04	−.01	.09
18. CEO compensation	13.52	.80	−.04	−.02	−.04	.09	.33	.10	.01	.08	−.03	−.01	−.07	.20
19. CEO tenure	6.71	3.54	.04	.04	−.05	.01	.08	.28	−.10	−.14	−.02	.04	.00	.03
20.Operational efficiency	.59	.37	.06	−.01	−.06	.17	.05	.02	.06	.05	−.06	−.02	−.17	.18
21.Capital intensity	.04	.03	.05	.06	−.07	−.01	.06	−.21	.08	−.04	.03	.03	−.14	.15
22.Pre-crisis stock price	12.41	13.40	.11	−.02	−.07	−.13	.07	−.16	.15	−.13	−.01	.01	.12	.36
23. Environmental dynamism	.05	.04	−.07	−.02	.26	.07	−.05	.09	.49	−.00	.04	−.01	−.00	−.21
24. Environmental munificence	.14	.14	.04	−.01	−.08	.04	.13	−.15	.80	−.09	−.03	.03	−.07	.27
25. State ownership	.27	.44	−.12	.02	−.14	.20	.30	.45	−.04	.28	−.03	−.24	−.14	.04

Table 3 (continued)

Variables	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Flexibility													
2. Military CEO													
3. Pre-shock risk taking													
4. LEV													
5. Size													
6. List age													
7. Growth													
8. CEO dality													
9. Independent directors													
10. Female directors													
11. Slack resources													
12. ROA													
13. PPE	1												
14. CAP	.36	1											
15. Ownership	.09	.15	1										
16. CEO gender	.05	.03	−.00	1									
17. CEO age	.08	.11	.06	.06	1								
18. CEO compensation	−.01	.24	.03	−.00	.07	1							
19. CEO tenure	.03	.02	−.17	.03	.27	.09	1						
20.Operational efficiency	.03	.08	.05	.02	−.04	.12	−.01	1					
21.Capital intensity	.41	.62	.06	.05	.01	.05	−.04	−.01	1				
22.Pre-crisis stock price	−.08	.15	.12	−.01	.02	.20	−.02	.11	.14	1			
23. Environmental dynamism	−.14	−.17	−.07	−.01	−.10	−.06	−.11	−.18	−.08	−.08	1		
24. Environmental munificence	−.05	.22	.06	−.01	−.05	.06	−.08	.14	.16	.25	.17	1	
25. State ownership	.16	.14	.14	.06	.09	.04	−.05	.04	−.08	−.03	−.04	−.11	1

Correlations≥|.01| are significant at $p \leq .05$. $N = 26{,}286$

Table 4 Regression analysis of the effects of CEOs with military experience on organizational resilience

	Stability (Severity of loss)	Stability (Severity of loss)	Flexibility (Time to recovery)	Flexibility (Time to recovery)
	Model 1	Model 2	Model 3	Model 4
LEV	.043+	.043+	−.398	−.393
	(.024)	(.024)	(.292)	(.291)
Size	−.000	−.000	−.103	−.101
	(.005)	(.005)	(.074)	(.074)
List age	−.000	−.001	−.164	−.151
	(.007)	(.007)	(.104)	(.105)
Growth	−.030	−.030	−.131	−.140
	(.020)	(.020)	(.276)	(.276)
Duality	−.001	−.001	−.043	−.048
	(.006)	(.006)	(.083)	(.083)
Independent directors	−.042	−.045	−.140	−.017
	(.049)	(.049)	(.646)	(.649)
Female directors	−.012	−.012	.131	.123
	(.023)	(.023)	(.282)	(.282)
Slack resources	−.000	−.000	.005	.002
	(.002)	(.002)	(.023)	(.023)
ROA	−.106	−.107	−.666	−.664
	(.067)	(.067)	(.834)	(.834)
PPE	.006	.005	.011	.029
	(.024)	(.024)	(.338)	(.338)
CAP	.001	.001	.064	.058
	(.004)	(.004)	(.058)	(.057)
Ownership	−.003	−.004	−.420**	−.397**
	(.009)	(.009)	(.131)	(.132)
CEO gender	−.021*	−.021+	.271+	.263+
	(.011)	(.011)	(.141)	(.142)
CEO age	−.000	−.000	−.008	−.008
	(.000)	(.000)	(.006)	(.006)
CEO compensation	−.005	−.005	−.021	−.017
	(.003)	(.003)	(.046)	(.046)
CEO tenure	−.000	−.000	.014	.012
	(.001)	(.001)	(.011)	(.011)
Operational efficiency	−.010	−.010	.007	.008
	(.007)	(.007)	(.109)	(.108)
Capital intensity	.105	.113	.362	.263
	(.128)	(.128)	(1.799)	(1.782)
Pre-shock stock price	.001***	.001***	.012***	.012***
	(.000)	(.000)	(.003)	(.003)
Environmental dynamism	.344***	.345***	−1.554	−1.470
	(.092)	(.092)	(1.041)	(1.040)

Table 4 (continued)

	Stability (Severity of loss) Model 1	Stability (Severity of loss) Model 2	Flexibility (Time to recovery) Model 3	Flexibility (Time to recovery) Model 4
Environmental munificence	.046	.045	.886	.901
	(.038)	(.038)	(.582)	(.581)
State ownership	−.018*	−.017*	.006	−.009
	(.007)	(.007)	(.102)	(.102)
Military CEO		−.039*		.811**
		(.017)		(.259)
Industry	Included	Included	Included	Included
N	1033	1033	26,286	26,286

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

a correlation between the independent variable, military CEO, and the dependent variable, firm stability ($\beta = -.039$, $p < .05$) in Model 4 in Table 7. (2) In Model 2, the result shows that the coefficient estimate of CEO military experience is negative and statistically significant with firms' pre-shock risk taking ($\beta = -.026$, $p < .05$). (3) In model 5, we find that once firms' pre-shock risk taking was entered, the effects of the military CEO on firm stability were diminished ($\beta = -.037$, $p < .05$).

A similar analytical step is applied to the case of firm flexibility as the dependent variable. (1) We establish the existence of a correlation between military CEOs and firm flexibility ($\beta = .811$, $p < .01$) in Model 7. (2) The result shows that the coefficient estimate of CEO military experience is negative and statistically significant with firms' pre-shock risk taking in Model 2($\beta = -.026$, $p < .05$). (3) In model 8, the result shows that the effect of the independent variable, CEO military experience, on the dependent variable, firm flexibility, is reduced when the mediators are included in the model ($\beta = .799$, $p < .01$). These results suggest that firms' pre-shock risk taking partially mediates the relationship between CEO military experience and firm stability, and firms' pre-shock risk taking partially mediates the relationship between CEO military experience and firm flexibility. Overall, Hypothesis 4 is supported.

Robustness tests

To assess the robustness, we reran all the analyses using the two-stage estimation of the Heckman selection model (Heckman, 1979) and propensity score matching (PSM) method (Rosenbaum & Rubin, 1983) to control for possible sample selection bias. Furthermore, we performed a series of tests to ensure that the preceding findings are robust to alternative measures, alternative subsamples in alternative window(s).

Table 5 Regression analysis of the effects of CEO with military experience on firms' per-shock risk taking

	Model 1	Model 2
LEV	−.003	−.003
	(.010)	(.010)
Size	.000	.000
	(.002)	(.002)
List age	.013***	.013***
	(.004)	(.004)
Growth	−.002	−.002
	(.004)	(.004)
CEO duality	.002	.002
	(.002)	(.002)
Independent directors	−.012	−.014
	(.017)	(.017)
Female directors	.006	.006
	(.009)	(.009)
Slack resources	.000	.001
	(.001)	(.001)
ROA	−.241***	−.242***
	(.035)	(.035)
PPE	.046***	.046***
	(.012)	(.012)
CAP	−.002	−.002
	(.001)	(.001)
Ownership	.004	.004
	(.004)	(.004)
CEO gender	.002	.002
	(.004)	(.004)
CEO age	−.000	−.000
	(.000)	(.000)
CEO education	.000	.000
	(.001)	(.001)
CEO compensation	.005***	.005***
	(.001)	(.001)
CEO tenure	−.000	−.000
	(.000)	(.000)
Environmental dynamism	.222***	.222***
	(.032)	(.032)
Environmental munificence	.000	.000
	(.010)	(.010)
State ownership	−.014***	−.013***
	(.003)	(.003)
Military CEO		−.014**
		(.005)
Year	Included	Included
Industry	Included	Included
N	2615	2615

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Robustness check using two-stage heckman selection model

We utilize the two-stage Heckman selection model to control for possible sample selection bias (Heckman, 1979). In the first stage, we regress a probit model to estimate the likelihood that the firm is headed by a military CEO. Similar to the approaches used in previous research (Benmelech & Frydman, 2015; Koch-Bayram & Wernicke, 2018; Law & Mills, 2017), we include age1977 as the instrumental variable, because we do not expect that this variable will affect firm resilience in a shock. We create the age1977 dummy that equals 1 if the CEO was 18 years old when China resumed the college entrance examination in 1977. We choose this instrumental variable, because according to the Military Service Law of the People's Republic of China, male citizens who are 18 years old by December 31 of each year should be recruited for military service. In addition, before the resumption of the college entrance examination in 1977, young people were likely to serve in the military, and the government typically arranged a job for them after they left the military. Hence, they could change their lives through their enlistment in the army. Thus, in the first-stage probit regression, we use firm size, LEV, ROA, growth, list age, industry dummy, and the age1977 dummy to predict the likelihood of being or having a military CEO. Next, we calculate an adjustment term called the inverse Mills ratio (Inverse) from the first-stage probit regression and introduce the ratio as a control variable into all the main equations in the second stage.

The results of the second-stage estimation of the Heckman model are presented in Tables 8, 9, and 10. Specifically, Table 8 shows the relationship between CEOs with military experience and firms' pre-shock risk taking based on the two-stage Heckman selection model. We can find that the coefficient of Military CEO is negative ($\beta = -.015$, $p < .01$), suggesting that CEOs' military experience has a strong negative effect on firms' risk taking before the shock.

Table 9 reveals the relationship between firms' pre-shock risk taking and firm resilience based on the two-stage Heckman selection model. In terms of stability, the coefficient of firms' pre-shock risk taking is positive ($\beta = .112$, $p < .10$), suggesting that firms' pre-shock risk taking has a strong positive influence on drop in stock price immediately after the shock. In terms of flexibility, the coefficient of firms' pre-shock risk taking is negative ($\beta = -1.851$, $p < .10$), suggesting that firms with high level of pre-shock risk taking are significantly likely to recover slowly.

Table 10 shows the mediating role of firms' pre-shock risk taking in the relationship between CEO military experience and firm resilience to exogenous shocks. In terms of stability, we first established the existence of a correlation between the CEO military experience and the firm stability ($\beta = -.040$, $p <. 05$). Next, the result shows that the coefficient estimate of CEO military experience is negative and statistically significant with firms' pre-shock risk taking ($\beta = -.026$, $p < .01$). Finally, we find that once firms' pre-shock risk taking was entered, the effects of the military CEO on firm stability were diminished in model 5 ($\beta = -.037$, $p < .05$).

In terms of flexibility, we first established the existence of a correlation between the CEO military experience and the firm flexibility ($\beta = .799$, $p < .01$).

Table 6 Regression analysis of the effects of firms' per-shock risk taking on organizational resilience

	Stability (Severity of loss)	Stability (Severity of loss)	Flexibility (Time to recovery)	Flexibility (Time to recovery)
	Model 1	Model 2	Model 3	Model 4
LEV	.043+	.044+	−.398	−.491+
	(.024)	(.024)	(.292)	(.297)
Size	−.000	−.000	−.103	−.096
	(.005)	(.005)	(.074)	(.074)
List age	−.000	−.002	−.164	−.151
	(.007)	(.007)	(.104)	(.105)
Growth	−.030	−.028	−.131	−.164
	(.020)	(.020)	(.276)	(.276)
CEO duality	−.001	−.002	−.043	−.026
	(.006)	(.006)	(.083)	(.082)
Independent directors	−.042	−.038	−.140	−.230
	(.049)	(.048)	(.646)	(.643)
Female directors	−.012	−.013	.131	.181
	(.023)	(.023)	(.282)	(.281)
Slack resources	−.000	−.001	.005	.008
	(.002)	(.002)	(.023)	(.023)
ROA	−.106	−.070	−.666	−1.776*
	(.067)	(.070)	(.834)	(.900)
PPE	.006	.001	.011	.021
	(.024)	(.025)	(.338)	(.340)
CAP	.001	.001	.064	.063
	(.004)	(.004)	(.058)	(.058)
Ownership	−.003	−.004	−.420**	−.414**
	(.009)	(.009)	(.131)	(.131)
CEO gender	−.021*	−.021*	.271+	.281*
	(.011)	(.011)	(.141)	(.141)
CEO age	−.000	−.000	−.008	−.008
	(.000)	(.000)	(.006)	(.006)
CEO compensation	−.005	−.005+	−.021	−.010
	(.003)	(.003)	(.046)	(.046)
CEO tenure	−.000	−.000	.014	.014
	(.001)	(.001)	(.011)	(.011)
Operational efficiency	−.010	−.011	.007	.024
	(.007)	(.007)	(.109)	(.109)
Capital intensity	.105	.104	.362	.532
	(.128)	(.126)	(1.799)	(1.780)
Pre-shock stock price	.001***	.001***	.012***	.013***
	(.000)	(.000)	(.003)	(.003)
Environmental dynamism	.344***	.312***	−1.554	−1.037
	(.092)	(.090)	(1.041)	(1.067)

Table 6 (continued)

	Stability (Severity of loss) Model 1	Stability (Severity of loss) Model 2	Flexibility (Time to recovery) Model 3	Flexibility (Time to recovery) Model 4
Environmental munificence	.046	.042	.886	1.005+
	(.038)	(.038)	(.582)	(.569)
State ownership	−.018*	−.016*	.006	−.015
	(.007)	(.007)	(.102)	(.103)
Pre-shock risk taking		.108+		−1.993*
		(.061)		(.943)
Industry	Included	Included	Included	Included
N	1033	1033	26,286	26,286

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Next, the result shows that the coefficient estimate of CEO military experience is negative and statistically significant with firms' pre-shock risk taking in Model 2 ($\beta = -.026$, $p < .01$). Finally, in model 8, the result shows that the effect of the independent variable, CEO military experience, on the dependent variable, firm flexibility, is reduced when the mediators are included in the model ($\beta = .787$, $p < .01$). Therefore, the two-stage Heckman selection model further verifies our hypotheses.

Robustness check using PSM method

The military observations comprise only a relatively small portion of our sample, and such a disproportion may induce sample selection bias and create endogeneity issues. To address this problem, we employ the PSM method proposed by Rosenbaum and Rubin (1983) to examine whether firms with CEOs who have military experience are highly resilient. The matching process is based on a propensity score, or in this study, the probability of a firm having a CEO with military experience, conditional on the observed firm characteristics. Specifically, following previous studies (Luo et al., 2017; Law & Mills, 2017; Guo et al., 2020), we used the following probit model (Model 6) to calculate the focal firm's propensity score:

$$Military\ CEO\ variable = f(Firm\ size + LEV + ROA + Slack\ Resources + PPE + CAP + Industry + \varepsilon) \tag{8}$$

where $f(.)$ is the probit function. Similar to previous research (Guo et al., 2020; Luo et al., 2017; Law & Mills, 2017), we regress military CEO on firm-level determinants and industry FEs. Specifically, the firm-level determinants included firm size, LEV, ROA, slack resources, PPE, and CAP which are related to the appointment of a CEO with military experience. We estimate the probit function using the maximum likelihood method.

Table 7 Regression analysis of the mediating effect

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
LEV	−.007	−.007	.043+	.043+	.044+	−.398	−.393	−.486
	(.014)	(.014)	(.024)	(.024)	(.024)	(.292)	(.291)	(.296)
Size	.001	.001	−.000	−.000	−.000	−.103	−.101	−.094
	(.003)	(.003)	(.005)	(.005)	(.005)	(.074)	(.074)	(.073)
List age	.015**	.015**	−.000	−.001	−.002	−.164	−.151	−.138
	(.005)	(.005)	(.007)	(.007)	(.007)	(.104)	(.105)	(.105)
Growth	−.016	−.016	−.030	−.030	−.029	−.131	−.140	−.172
	(.013)	(.013)	(.020)	(.020)	(.020)	(.276)	(.276)	(.275)
CEO duality	.004	.004	−.001	−.001	−.002	−.043	−.048	−.031
	(.003)	(.003)	(.006)	(.006)	(.006)	(.083)	(.083)	(.082)
Independent directors	−.030	−.032	−.042	−.045	−.042	−.140	−.017	−.109
	(.026)	(.026)	(.049)	(.049)	(.048)	(.646)	(.649)	(.647)
Female directors	.005	.005	−.012	−.012	−.013	.131	.123	.171
	(.012)	(.012)	(.023)	(.023)	(.023)	(.282)	(.282)	(.281)
Slack resources	.001	.001	−.000	−.000	−.000	.005	.002	.005
	(.001)	(.001)	(.002)	(.002)	(.002)	(.023)	(.023)	(.023)
ROA	−.330***	−.331***	−.106	−.107	−.073	−.666	−.664	−1.759+
	(.050)	(.050)	(.067)	(.067)	(.070)	(.834)	(.834)	(.901)
PPE	.047**	.047**	.006	.005	.000	.011	.029	.039
	(.018)	(.018)	(.024)	(.024)	(.025)	(.338)	(.338)	(.340)
CAP	−.002	−.002	.001	.001	.001	.064	.058	.057
	(.003)	(.003)	(.004)	(.004)	(.004)	(.058)	(.057)	(.057)
Ownership	.004	.004	−.003	−.004	−.004	−.420**	−.397**	−.392**
	(.005)	(.005)	(.009)	(.009)	(.009)	(.131)	(.132)	(.132)
CEO gender	.002	.002	−.021*	−.021+	−.021+	.271+	.263+	.274+
	(.005)	(.005)	(.011)	(.011)	(.011)	(.141)	(.142)	(.142)
CEO age	−.000	.000	−.000	−.000	−.000	−.008	−.008	−.008
	(.000)	(.000)	(.000)	(.000)	(.000)	(.006)	(.006)	(.006)
CEO compensation	.006***	.006***	−.005	−.005	−.005	−.021	−.017	−.007
	(.002)	(.002)	(.003)	(.003)	(.003)	(.046)	(.046)	(.047)
CEO tenure	−.001	−.001	−.000	−.000	−.000	.014	.012	.012
	(.000)	(.000)	(.001)	(.001)	(.001)	(.011)	(.011)	(.011)
Operational efficiency	.009	.009	−.010	−.010	−.011	.007	.008	.025
	(.006)	(.006)	(.007)	(.007)	(.007)	(.109)	(.108)	(.108)
Capital intensity	.010	.015	.105	.113	.111	.362	.263	.430
	(.083)	(.084)	(.128)	(.128)	(.126)	(1.799)	(1.782)	(1.763)
Pre-shock stock price	.000*	.000*	.001***	.001***	.001***	.012***	.012***	.013***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.003)	(.003)	(.003)
Environmental dynamism	.297***	.298***	.344***	.345***	.315***	−1.554	−1.470	−.963
	(.052)	(.052)	(.092)	(.092)	(.090)	(1.041)	(1.040)	(1.066)

Table 7 (continued)

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Environmental munificence	.033	.033	.046	.045	.042	.886	.901	1.017+
	(.025)	(.025)	(.038)	(.038)	(.038)	(.582)	(.581)	(.568)
State ownership	−.017***	−.017***	−.018*	−.017*	−.016*	.006	−.009	−.031
	(.004)	(.004)	(.007)	(.007)	(.007)	(.102)	(.102)	(.103)
Military CEO		−.026**		−.039*	−.037*		.811**	.799**
		(.009)		(.017)	(.017)		(.259)	(.256)
Pre-shock Risk taking					.102+			−1.828+
					(.061)			(1.060)
Industry	Included	Included	Included	Included	Included	Included	Included	Included
Number of firms	1033	1033	1033	1033	1033	1033	1033	1033
Number of firms recovered						894	894	894
Observations	1033	1033	1033	1033	1033	26,286	26,286	26,286

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

We then match those firms run by military CEOs to those run by non-military CEOs based on the estimated propensity score from the model. We adopt the one-nearest neighbor matching approach to identify the non-military subsample that matching the military subsample. Then, we rerun all the main models on the matched samples to examine our hypotheses.

Tables 11, 12, and 13 display the regression results after using PSM method. Specifically, Table 11 shows the relationship between CEOs with military experience and firms' pre-shock risk taking. As Model 2 shows, the coefficient of Military CEO is negative ($\beta = -.013$, $p < .001$), suggesting that CEOs' military experience has a strong negative effect on firms' risk taking before the pandemic shock.

Table 12 shows the relationship between firms' pre-shock risk taking and organizational resilience. The result of Model 2 shows that the coefficient of firms' pre-shock risk taking is positive ($\beta = .934$, $p < .05$). Model 4 shows that the coefficient of firms' pre-shock risk taking is negative ($\beta = -23.816$, $p < .10$). That is, the results after using PSM method are generally consistent with those in Table 6.

Furthermore, we test the mediating role of firms' pre-shock risk taking in the relationship between CEOs' military experience and firms' resilience to exogenous shocks using the PSM method in Table 13. In terms of stability, we first established the existence of a correlation between the CEO military experience and the firm stability ($\beta = -.155$, $p < .05$). Next, the result shows that the coefficient estimate of CEO military experience is negative and statistically significant with firms' pre-shock risk taking ($\beta = -.158$, $p < .10$). Finally, we find that once firms' pre-shock

Table 8 Robust test: effects of CEO with military experience on firms' per-shock risk taking based on the two-stage Heckman selection model

	Model 1	Model 2
LEV	.014	.015
	(.017)	(.017)
Size	.000	.000
	(.003)	(.003)
List age	.017**	.017**
	(.006)	(.006)
Growth	−.000	−.000
	(.005)	(.005)
CEO duality	.002	.002
	(.003)	(.003)
Independent directors	−.019	−.021
	(.020)	(.020)
Female directors	−.003	−.003
	(.010)	(.010)
Slack resources	.001	.001
	(.001)	(.001)
ROA	−.237***	−.238***
	(.044)	(.044)
PPE	.064***	.064***
	(.014)	(.014)
CAP	−.003+	−.003
	(.002)	(.002)
Ownership	.007	.006
	(.004)	(.004)
CEO gender	.002	.002
	(.004)	(.004)
CEO age	.000	.000
	(.000)	(.000)
CEO education	.001	.001
	(.001)	(.001)
CEO compensation	.008***	.008***
	(.002)	(.002)
CEO tenure	−.000	−.000
	(.000)	(.000)
Environmental dynamism	.224***	.224***
	(.042)	(.042)
Environmental munificence	.002	.002
	(.013)	(.013)
State ownership	−.013***	−.012***
	(.004)	(.004)
Inverse	−.009	−.010
	(.009)	(.009)

Table 8 (continued)

	Model 1	Model 2
Military CEO		−.015**
		(.005)
Year	Included	Included
Industry	Included	Included
N	1952	1952

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

risk taking was entered, the effects of the military CEO on firm stability were diminished in model 5 ($\beta = -.070$, $p < .10$).

In terms of flexibility, we first established the existence of a correlation between the CEO's military experience and firm flexibility ($\beta = 3.540$, $p < .05$). Next, the result shows that the coefficient estimate of CEO military experience is negative and statistically significant with firms' pre-shock risk taking in Model 2 ($\beta = -.158$, $p < .10$). Finally, in model 8, the result shows that the effect of the independent variable, CEO military experience, on the dependent variable, firm flexibility, is reduced when the mediators are included in the model ($\beta = 3.534$, $p < .10$). Overall, the results support all the hypotheses.

Alternative measure for firms' pre-shock risk taking

According to previous studies (Hirshleifer et al., 2012; Sunder et al., 2017), we rerun the regressions using R&D expenditure as the measure of degrees of profitability volatility to indicate the firms' risk taking before the pandemic. The results support all our hypotheses. Specifically, Tables 14, 15, and 16 display the regression results after we use the alternative measure for firms' risk taking. Table 14 shows the relationship between CEOs with military experience and firms' pre-shock risk taking. Model 2 shows that the coefficient of Military CEO is negative ($\beta = -.014$, $p < .01$), suggesting that CEOs military experience has a strong negative effect on firms' risk taking before the pandemic shock.

Table 15 depicts the relationship between firms' pre-shock risk taking and organizational resilience using the alternative measure for firms' risk taking. The result of Model 2 shows that the coefficient of firms' pre-shock risk taking is positive ($\beta = .001$, $p < .05$), whereas Model 4 reveals that the coefficient of firms' pre-shock risk taking is negative ($\beta = -.015$, $p < .1$). That is, the results obtained with the PSM method are generally consistent with those in Table 6.

Furthermore, we test the mediating role of firms' pre-shock risk taking in the relationship between CEOs' military experience and firms' resilience to exogenous shocks using the PSM method in Table 16. In terms of stability, we first established the existence of a correlation between the CEO military experience and the firm stability ($\beta = -.049$, $p < .05$). Next, the result shows that the coefficient estimate

Table 9 Robust test: effects of firms' per-shock risk taking on organizational resilience based on the two-stage Heckman selection model

	Stability (Severity of loss)	Stability (Severity of loss)	Flexibility (Time to recovery)	Flexibility (Time to recovery)
	Model 1	Model 2	Model 3	Model 4
LEV	.090	.090	.028	−.071
	(.057)	(.057)	(.432)	(.437)
Size	−.009	−.009	−.165+	−.157+
	(.011)	(.011)	(.085)	(.085)
List age	.041	.039	.226	.235
	(.045)	(.045)	(.296)	(.298)
Growth	.027	.027	.455	.418
	(.066)	(.066)	(.511)	(.515)
CEO duality	−.001	−.002	−.047	−.030
	(.006)	(.006)	(.082)	(.082)
Independent directors	−.040	−.037	−.078	−.167
	(.049)	(.049)	(.649)	(.647)
Female directors	−.011	−.013	.153	.201
	(.023)	(.023)	(.282)	(.281)
Slack resources	−.000	−.001	.004	.006
	(.002)	(.002)	(.023)	(.023)
ROA	−.086	−.049	−1.294	−2.403*
	(.069)	(.072)	(.948)	(1.012)
PPE	.006	.001	−.002	.010
	(.024)	(.025)	(.338)	(.340)
CAP	.001	.001	.064	.063
	(.004)	(.004)	(.057)	(.057)
Ownership	−.003	−.003	−.373**	−.369**
	(.009)	(.009)	(.135)	(.135)
CEO gender	−.021*	−.022*	.280*	.291*
	(.011)	(.011)	(.141)	(.141)
CEO age	−.000	−.000	−.004	−.005
	(.001)	(.001)	(.006)	(.006)
CEO compensation	−.004	−.005	−.015	−.004
	(.003)	(.003)	(.046)	(.047)
CEO tenure	−.000	−.000	.014	.014
	(.001)	(.001)	(.011)	(.011)
Operational efficiency	−.010	−.011	.004	.021
	(.007)	(.007)	(.110)	(.110)
Capital intensity	.101	.099	.309	.477
	(.128)	(.126)	(1.798)	(1.777)
Precrisis stock price	.001***	.001***	.013***	.013***
	(.000)	(.000)	(.003)	(.003)
Environmental dynamism	.345***	.313***	−1.468	−.947
	(.092)	(.091)	(1.040)	(1.067)

Table 9 (continued)

	Stability (Severity of loss) Model 1	Stability (Severity of loss) Model 2	Flexibility (Time to recovery) Model 3	Flexibility (Time to recovery) Model 4
Environmental munificence	.042	.039	.857	.977+
	(.038)	(.038)	(.584)	(.570)
State ownership	−.018**	−.016*	.013	−.007
	(.007)	(.007)	(.102)	(.102)
Inverse	−.081	−.079	−1.318	−1.307
	(.089)	(.089)	(.960)	(.968)
Pre-shock risk taking		.112+		−1.851+
		(.064)		(1.064)
Industry	Included	Included	Included	Included
N	1033	1033	26,286	26,286

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

of CEO military experience is negative and statistically significant with firms' pre-shock risk taking ($\beta = -2.230$, $p < .05$). Finally, we find that once firms' pre-shock risk taking was entered, the effects of the military CEO on firm stability were diminished in model 5 ($\beta = -.046$, $p < .05$).

In terms of flexibility, we first established the existence of a correlation between the CEO's military experience and firm flexibility ($\beta = .555$, $p < .10$). Next, the result shows that the coefficient estimate of CEO military experience is negative and statistically significant with firms' pre-shock risk taking in Model 2 ($\beta = -2.230$, $p < .05$). Finally, in model 8, the result shows that the effect of the independent variable, CEO military experience, on the dependent variable, firm flexibility, is reduced when the mediators are included in the model ($\beta = .537$, $p< 0\ .10$). Overall, the results support all the hypotheses. Overall, our results support all the hypotheses.

Alternative measure for organizational resilience

According to previous studies (Ortiz-de-Mandojana & Bansal, 2016; Lv et al., 2019), we rerun the regressions using *financial volatility* as the alternative measure of organizational resilience. Financial volatility was measured as stock return volatility. We calculated the standard deviation of the monthly stock return for the year (Schwert, 1990). The results support all our hypotheses.

In Table 17, the result of Model 2 shows that the relationship between firms' pre-shock risk taking and organizational resilience is positive ($\beta = .108$, $p < .05$). Furthermore, we test the mediating role of firms' pre-shock risk taking in the relationship between CEOs' military experience and firms' resilience to exogenous shocks using the alternative measure for organizational resilience, and the results are presented in Table 18. Specifically, Model 2 in Table 18 shows that CEOs' military experience is negatively related to firms' pre-shock risk taking ($\beta = -.026$, $p <$

Table 10 Robust test: regression analysis of the mediating effect based on the two-stage Heckman selection model

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
LEV	−.001	.001	.090	.094	.094	.028	.013	−.086
	(.027)	(.027)	(.057)	(.057)	(.057)	(.432)	(.429)	(.435)
Size	.000	−.000	−.009	−.010	−.010	−.165+	−.160+	−.153+
	(.006)	(.006)	(.011)	(.011)	(.011)	(.085)	(.085)	(.085)
List age	.023	.025	.041	.044	.041	.226	.221	.230
	(.022)	(.022)	(.045)	(.045)	(.045)	(.296)	(.293)	(.294)
Growth	−.004	−.001	.027	.031	.031	.455	.419	.383
	(.030)	(.030)	(.066)	(.066)	(.066)	(.511)	(.508)	(.512)
CEO duality	.006+	.006+	−.001	−.001	−.002	−.047	−.051	−.034
	(.003)	(.003)	(.006)	(.006)	(.006)	(.082)	(.082)	(.081)
Independent directors	−.027	−.029	−.040	−.044	−.040	−.078	.042	−.048
	(.026)	(.026)	(.049)	(.049)	(.049)	(.649)	(.653)	(.651)
Female directors	.012	.012	−.011	−.011	−.012	.153	.143	.190
	(.013)	(.013)	(.023)	(.023)	(.023)	(.282)	(.282)	(.280)
Slack resources	.001	.001	−.000	−.000	−.000	.004	.001	.003
	(.001)	(.001)	(.002)	(.002)	(.002)	(.023)	(.023)	(.023)
ROA	−.329***	−.329***	−.086	−.086	−.052	−1.294	−1.264	−2.357*
	(.050)	(.050)	(.069)	(.069)	(.072)	(.948)	(.947)	(1.010)
PPE	.042*	.041*	.006	.005	.001	−.002	.018	.030
	(.018)	(.018)	(.024)	(.025)	(.025)	(.338)	(.339)	(.340)
CAP	−.003	−.002	.001	.001	.001	.064	.058	.057
	(.003)	(.003)	(.004)	(.004)	(.004)	(.057)	(.057)	(.057)
Ownership	.006	.005	−.003	−.003	−.004	−.373**	−.354**	−.349*
	(.005)	(.005)	(.009)	(.009)	(.009)	(.135)	(.136)	(.136)
CEO gender	.003	.003	−.021*	−.021+	−.021*	.280*	.273+	.283*
	(.005)	(.005)	(.011)	(.011)	(.011)	(.141)	(.142)	(.142)
CEO age	.000	.000	−.000	−.000	−.000	−.004	−.004	−.005
	(.000)	(.000)	(.001)	(.001)	(.001)	(.006)	(.006)	(.006)
CEO compensation	.006**	.006**	−.004	−.004	−.005	−.015	−.012	−.001
	(.002)	(.002)	(.003)	(.003)	(.003)	(.046)	(.047)	(.047)
CEO tenure	−.001	−.001	−.000	−.000	−.000	.014	.012	.012
	(.000)	(.000)	(.001)	(.001)	(.001)	(.011)	(.011)	(.011)
Operational efficiency	.008	.008	−.010	−.010	−.011	.004	.005	.022
	(.006)	(.006)	(.007)	(.007)	(.007)	(.110)	(.109)	(.109)
Capital intensity	.020	.025	.101	.109	.106	.309	.227	.392
	(.086)	(.086)	(.128)	(.128)	(.126)	(1.798)	(1.781)	(1.760)
Precrisis stock price	.000*	.000*	.001***	.001***	.001***	.013***	.013***	.014***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.003)	(.003)	(.003)

Table 10 (continued)

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Environmental dynamism	.290***	.291***	.345***	.347***	.316***	−1.468	−1.390	−.881
	(.052)	(.052)	(.092)	(.092)	(.091)	(1.040)	(1.039)	(1.065)
Environmental munificence	.032	.032	.042	.042	.038	.857	.873	.990+
	(.025)	(.025)	(.038)	(.038)	(.038)	(.584)	(.583)	(.570)
State ownership	−.017***	−.016***	−.018**	−.018**	−.016*	.013	−.003	−.024
	(.004)	(.004)	(.007)	(.007)	(.007)	(.102)	(.102)	(.103)
Inverse	−.017	−.021	−.081	−.087	−.084	−1.318	−1.258	−1.245
	(.041)	(.041)	(.089)	(.089)	(.089)	(.960)	(.951)	(.959)
Military CEO		−.026**		−.040*	−.037*		.799**	.787**
		(.009)		(.017)	(.017)		(.261)	(.258)
Pre-shock Risk taking					.106+			−1.827+
					(.064)			(1.063)
Industry	Included	Included	Included	Included	Included	Included	Included	Included
Observations	1033	1033	1033	1033	1033	26,286	26,286	26,286

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

.01). In Model 4, CEOs' military experience is negatively related to organizational resilience ($\beta = -.029$, $p < .05$). In model 5, once firms' pre-shock risk taking was entered, the effects of CEOs' military experience on financial volatility were diminished ($\beta = -.027$, $p < .05$). These results suggest that firms' pre-shock risk taking partially mediates the negative relationship between CEOs' military experience and organizational resilience.

Robustness checks in alternative window(s)

We extended the observation period and reran the regressions. Acknowledging the spread of fear and reported cases before the Wuhan lockdown on January 23, 2020, we adjusted the systemic shock's start date to December 30, 2019. This date marks the government's first official public announcement about COVID-19, when authorities issued an emergency notice for medical facilities to track and report treatments. Additionally, we included June 30, 2020, and December 31, 2020, as new endpoints for the study. Consequently, we established two new study periods: a six-month window from December 30, 2019, to June 30, 2020, and a one-year window from December 30, 2019, to December 31, 2020. The regressions were rerun for these periods. Tables 19 and 20 present robust results for the six-month window, while Tables 21 and 22 do so for the one-year window. We observed no significant changes in our findings.

Table 11 Robust test: effects of CEO with military experience on firms' per-shock risk taking (PSM)

	Model 1	Model 2
LEV	.022	.015
	(.047)	(.044)
Size	.013**	.013***
	(.004)	(.003)
List age	.005	.000
	(.013)	(.015)
Growth	−.009	−.010
	(.006)	(.006)
CEO duality	−.014	−.012
	(.012)	(.011)
Independent directors	.098	.068
	(.067)	(.058)
Female directors	.044***	.041***
	(.006)	(.006)
Slack resources	.004*	.003*
	(.001)	(.001)
ROA	−.137	−.133
	(.189)	(.198)
PPE	.065*	.063
	(.028)	(.041)
CAP	.001	.001
	(.004)	(.003)
Ownership	−.001	−.002
	(.030)	(.027)
CEO gender	−.018+	−.016**
	(.010)	(.005)
CEO age	.001*	.002*
	(.001)	(.001)
CEO education	−.009	−.008
	(.009)	(.009)
CEO compensation	.013***	.013***
	(.002)	(.002)
CEO tenure	−.003	−.002
	(.003)	(.004)
Military CEO		−.013***
		(.003)
Year	Included	Included
Industry	Included	Included
N	70	70

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 12 Robust test: effects of firms' per-shock risk taking on organizational resilience (PSM)

	Stability (Severity of loss) Model 1	Stability (Severity of loss) Model 2	Flexibility (Time to recovery) Model 3	Flexibility (Time to recovery) Model 4
LEV	.093	.174*	−1.705	−2.929
	(.189)	(.036)	(4.162)	(4.489)
Size	.024	.038+	−2.458	−3.537+
	(.091)	(.012)	(2.559)	(2.136)
List age	.045	−.002	−.431	−.216
	(.131)	(.017)	(1.866)	(1.426)
Growth	−.032	−.277	2.323	9.303*
	(.520)	(.111)	(2.168)	(4.163)
CEO duality	.172	.177**	−1.064	−2.069+
	(.084)	(.018)	(.939)	(1.175)
Independent directors	−.817	−1.078*	22.552**	31.191+
	(.861)	(.163)	(8.426)	(16.395)
Female directors	.304	.551*	7.789*	7.764*
	(.606)	(.127)	(3.197)	(3.353)
Slack resources	.010	.014+	−.200	−.226
	(.015)	(.004)	(.179)	(.195)
ROA	−.571	−.567*	−15.630*	−24.225**
	(.497)	(.120)	(7.210)	(8.036)
PPE	.353	.449+	9.492*	14.160***
	(.568)	(.106)	(4.685)	(3.733)
CAP	.016	.025	3.605	4.513*
	(.120)	(.012)	(2.406)	(1.897)
Ownership	−.102	−.068+	6.345	3.403
	(.113)	(.022)	(5.029)	(5.084)
CEO gender	−.265	−.206**	6.818***	6.472**
	(.156)	(.018)	(1.724)	(2.273)
CEO age	.010	.012*	−.032	−.001
	(.005)	(.002)	(.140)	(.131)
CEO compensation	−.048	−.050*	−1.044*	−1.418+
	(.029)	(.005)	(.420)	(.783)
CEO tenure	−.011	−.011**	−.177+	−.222*
	(.011)	(.001)	(.102)	(.099)
Operational efficiency	−.059	−.123*	−1.057	−2.393
	(.156)	(.020)	(1.862)	(2.338)
Capital intensity	−1.240	−1.491*	−91.424	−123.892**
	(3.053)	(.263)	(63.834)	(47.778)
Precrisis stock price	.022	.024**	.161***	.201***
	(.011)	(.002)	(.044)	(.057)
Pre-shock risk taking		.934*		−23.816+
		(.100)		(13.321)
Industry	Included	Included	Included	Included
N	30	30	582	582

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 13 Robust test: regression analysis of the mediating effect (PSM)

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
LEV	−.087	−.016	.093	.163+	.171*	−1.705	.093	−4.950
	(.197)	(.078)	(.189)	(.042)	(.004)	(4.162)	(1.939)	(12.636)
Size	−.015	−.025	.024	.014	.028*	−2.458	−6.775	−7.218+
	(.093)	(.029)	(.091)	(.016)	(.002)	(2.559)	(6.220)	(3.896)
List age	.050	−.122	.045	−.123+	−.058+	−.431	3.304	4.429
	(.140)	(.055)	(.131)	(.030)	(.006)	(1.866)	(3.195)	(3.976)
Growth	.262	.155	−.032	−.136	−.220*	2.323	1.425**	18.035*
	(.574)	(.250)	(.520)	(.134)	(.009)	(2.168)	(3.819)	(8.736)
CEO duality	−.005	−.061	.172	.117*	.150*	−1.064	−2.885	−3.414*
	(.094)	(.046)	(.084)	(.024)	(.003)	(.939)	(2.768)	(1.614)
Independent directors	.280	−.189	−.817	−1.275*	−1.174**	22.552**	33.808*	53.424
	(.949)	(.404)	(.861)	(.218)	(.016)	(8.426)	(14.502)	(33.158)
Female directors	−.265	−.151	.304	.415	.497*	7.789*	7.281	6.029
	(.668)	(.294)	(.606)	(.159)	(.011)	(3.197)	(7.061)	(4.511)
Slack resources	−.004	−.009	.010	.006	.010*	−.200	−.239	−.391
	(.016)	(.008)	(.015)	(.005)	(.000)	(.179)	(.271)	(.370)
ROA	−.005	.192	−.571	−.379	−.482*	−15.630*	−35.401***	−44.707***
	(.532)	(.288)	(.497)	(.156)	(.010)	(7.210)	(9.351)	(11.226)
PPE	−.102	−.184	.353	.273	.372*	9.492*	14.994	18.289***
	(.628)	(.259)	(.568)	(.137)	(.013)	(4.685)	(1.627)	(5.221)
CAP	−.009	.027	.016	.051+	.037*	3.605	7.576	7.993*
	(.126)	(.030)	(.120)	(.016)	(.002)	(2.406)	(6.032)	(3.621)
Ownership	−.037	.100	−.102	.032	−.022	6.345	11.186*	1.492*
	(.127)	(.063)	(.113)	(.033)	(.005)	(5.029)	(5.196)	(4.568)
CEO gender	−.063	.170	−.265	−.037	−.129*	6.818***	12.673**	13.283**
	(.170)	(.076)	(.156)	(.041)	(.009)	(1.724)	(4.612)	(4.445)
CEO age	−.002	−.001	.010	.011*	.012**	−.032	−.130	−.019
	(.005)	(.004)	(.005)	(.002)	(.000)	(.140)	(.347)	(.371)
CEO compensation	.002	.061+	−.048	.010	−.023+	−1.044*	−.707+	−.944*
	(.028)	(.021)	(.029)	(.011)	(.003)	(.420)	(.383)	(.428)
CEO tenure	.000	.008	−.011	−.003	v.007*	−.177+	−.192	−.298
	(.012)	(.003)	(.011)	(.002)	(.000)	(.102)	(.223)	(.277)
Operational efficiency	.069	.113+	−.059	−.016	−.076+	−1.057	−.627	−2.189
	(.162)	(.038)	(.156)	(.020)	(.006)	(1.862)	(1.896)	(2.595)
Capital intensity	.269	−.126	−1.240	−1.626+	−1.559*	−91.424	−189.922	−197.809*
	(3.222)	(.681)	(3.053)	(.381)	(.048)	(63.834)	(166.920)	(97.785)
Precrisis stock price	−.003	−.013+	.022	.012*	.019*	.161***	.318*	.331***
	(.012)	(.004)	(.011)	(.002)	(.001)	(.044)	(.129)	(.081)
Military CEO		−.158+		−.155*	−.070+		3.540*	3.534+
		(.037)		(.020)	(.008)		(1.405)	(1.982)
Pre-shock Risk taking					.539+			−21.561+
					(.046)			(12.066)
Industry	Included	Included	Included	Included	Included	Included	Included	Included
N	30	30	30	30	30	582	582	582

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 14 Robust test: effects of CEO with military experience on firms' per-shock risk taking based on the alternative measure for firms' per-shock risk taking (R&D expenditure)

	Model 1	Model 2
LEV	−.003	−.003
	(.010)	(.010)
Size	.000	.000
	(.002)	(.002)
List age	.013***	.013***
	(.004)	(.004)
Growth	−.002	−.002
	(.004)	(.004)
CEO duality	.002	.002
	(.002)	(.002)
Independent directors	−.012	−.014
	(.017)	(.017)
Female directors	.006	.006
	(.009)	(.009)
Slack resources	.000	.001
	(.001)	(.001)
ROA	−.241***	−.242***
	(.035)	(.035)
PPE	.046***	.046***
	(.012)	(.012)
CAP	−.002	−.002
	(.001)	(.001)
Ownership	.004	.004
	(.004)	(.004)
CEO gender	.002	.002
	(.004)	(.004)
CEO age	−.000	−.000
	(.000)	(.000)
CEO education	.000	.000
	(.001)	(.001)
CEO compensation	.005***	.005***
	(.001)	(.001)
CEO tenure	−.000	−.000
	(.000)	(.000)
Environmental dynamism	.222***	.222***
	(.032)	(.032)
Environmental munificence	.000	.000
	(.010)	(.010)
State ownership	−.014***	−.013***
	(.003)	(.003)
Military CEO		−.014**
		(.005)
Year	Included	Included
Industry	Included	Included
N	2615	2615

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 15 Robust test: effects of firms' per-shock risk taking on organizational resilience based on the alternative measure for firms' per-shock risk taking (R&D expenditure)

	Stability (Severity of loss)	Stability (Severity of loss)	Flexibility (Time to recovery)	Flexibility (Time to recovery)
	Model 1	Model 2	Model 3	Model 4
LEV	.042+	.044*	−.398	−.387
	(.022)	(.022)	(.306)	(.305)
Size	−.000	.001	−.103	−.121
	(.005)	(.005)	(.076)	(.077)
List age	−.000	.001	−.164	−.185+
	(.007)	(.007)	(.103)	(.103)
Growth	−.040*	−.039*	−.131	−.084
	(.018)	(.018)	(.277)	(.280)
CEO duality	−.002	−.002	−.043	−.046
	(.006)	(.006)	(.083)	(.083)
Independent directors	−.045	−.053	−.140	−.109
	(.049)	(.049)	(.685)	(.685)
Female directors	−.014	−.012	.131	.093
	(.022)	(.022)	(.298)	(.299)
Slack resources	−.001	−.001	.005	.011
	(.002)	(.002)	(.023)	(.023)
ROA	−.111*	−.100*	−.666	−.684
	(.048)	(.049)	(.639)	(.639)
PPE	.005	.010	.011	−.021
	(.023)	(.023)	(.338)	(.339)
CAP	−.000	−.001	.064	.078
	(.004)	(.004)	(.062)	(.062)
Ownership	−.003	.000	−.420**	−.448**
	(.009)	(.010)	(.136)	(.137)
CEO gender	−.022*	−.022*	.271+	.274+
	(.010)	(.010)	(.144)	(.144)
CEO age	−.000	−.000	−.008	−.008
	(.000)	(.000)	(.006)	(.006)
CEO compensation	−.004	−.004	−.021	−.011
	(.003)	(.003)	(.047)	(.047)
CEO tenure	−.000	−.000	.014	.013
	(.001)	(.001)	(.011)	(.011)
Operational efficiency	−.010	−.006	.007	−.041
	(.008)	(.008)	(.115)	(.118)
Capital intensity	.128	.136	.362	.245
	(.131)	(.131)	(1.843)	(1.841)
Precrisis stock price	.001***	.001***	.012***	.013***
	(.000)	(.000)	(.003)	(.003)
Environmental dynamism	.320***	.312***	−1.554	−1.630
	(.076)	(.076)	(1.103)	(1.105)

Table 15 (continued)

	Stability (Severity of loss) Model 1	Stability (Severity of loss) Model 2	Flexibility (Time to recovery) Model 3	Flexibility (Time to recovery) Model 4
Environmental munificence	.060+	.059	.886+	.823
	(.036)	(.036)	(.530)	(.534)
State ownership	−.016*	−.016*	.006	.006
	(.007)	(.007)	(.105)	(.105)
Pre-shock risk taking (R&D)		.001*		−.015+
		(.001)		(.009)
Industry	Included	Included	Included	Included
N	1033	1033	26,286	26,286

Standard errors in parentheses; + p <.10, * p < .05, ** p < .01, *** p < .001

Supplementary analyses

We theorize about, but do not measure, the consumption of slack resources as a result of high-level risk-taking strategies. Our argument is that risky projects typically require a large amount of fixed investment, such as high capital expenditures and large R&D investments, which can lock in and exhaust a firm's internal resources that can be used to maintain its performance during shock periods (Bargeron et al., 2010; Hilary & Hui, 2009; Kantur & Iseri-Say, 2012; Mallak, 1998). To validate this, we conduct supplementary analyses to ensure the robustness of our findings.

Specifically, to test for the influence of the firms' risk taking on slack resources before the shock, we use the following model:

$$\text{slack resources} = \beta_0 + \beta_1 \text{firms' risk taking} + \sum Control + \sum Industry + \sum year + \varepsilon \tag{9}$$

In Table 23, we show the results of our OLS regressions using our sample of 1,033 CEOs of Chinese listed firms from 2017 to 2019 (before the COVID-19 pandemic). In model 2, the coefficient estimate of pre-shock risk taking is negative and statistically significant ($\beta = -.034$, $p < .05$). This result confirms our main conceptual argument that slack resources, which are bound to be affected by a firm's risk taking before a shock, play an important role in determining whether a firm can recover from and build resilience to a shock.

Discussion

Why are some firms hit hard by exogenous shocks while others recover quickly? To answer this question, we develop a theoretical model that integrates insights from upper echelon theory and the emerging literature on organizational resilience. As

Table 16 Robust test: regression analysis of the mediating effect based on the alternative measure for firms' per-shock risk taking (R&D expenditure)

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
LEV	−1.407	−1.410	.042+	.042+	.044+	−.398	−.412	−.400
	(1.094)	(1.031)	(.022)	(.022)	(.022)	(.306)	(.307)	(.306)
Size	−.923***	−.928***	−.000	−.000	.001	−.103	−.097	−.115
	(.214)	(.247)	(.005)	(.005)	(.005)	(.076)	(.077)	(.077)
List age	−.816*	−.866**	−.000	−.001	−.000	−.164	−.156	−.177+
	(.334)	(.331)	(.007)	(.007)	(.007)	(.103)	(.103)	(.103)
Growth	−.634	−.624	−.040*	−.040*	−.039*	−.131	−.131	−.086
	(1.266)	(.844)	(.018)	(.018)	(.018)	(.277)	(.277)	(.280)
CEO duality	−.329	−.329	−.002	−.002	−.002	−.043	−.047	−.050
	(.284)	(.277)	(.006)	(.006)	(.006)	(.083)	(.083)	(.083)
Independent directors	5.120*	4.861*	−.045	−.051	−.058	−.140	−.084	−.055
	(2.086)	(2.238)	(.049)	(.049)	(.049)	(.685)	(.686)	(.687)
Female directors	−1.630+	−1.679+	−.014	−.015	−.013	.131	.136	.098
	(.933)	(.990)	(.022)	(.022)	(.022)	(.298)	(.299)	(.299)
Slack resources	.304*	.317***	−.001	−.000	−.001	.005	.004	.009
	(.123)	(.081)	(.002)	(.002)	(.002)	(.023)	(.023)	(.023)
ROA	−7.751**	−7.788***	−.111*	−.112*	−.102*	−.666	−.663	−.680
	(2.907)	(2.216)	(.048)	(.048)	(.048)	(.639)	(.640)	(.640)
PPE	−3.243**	−3.311**	.005	.004	.008	.011	.008	−.023
	(1.254)	(1.061)	(.023)	(.023)	(.023)	(.338)	(.338)	(.340)
CAP	.774***	.782***	−.000	−.000	−.001	.064	.059	.072
	(.179)	(.194)	(.004)	(.004)	(.004)	(.062)	(.062)	(.062)

Table 16 (continued)

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Ownership	−1.781***	−1.823***	−.003	−.003	−.001	−.420**	−.419**	−.446**
	(.485)	(.434)	(.009)	(.009)	(.010)	(.136)	(.136)	(.137)
CEO gender	.307	.324	−.022*	−.022*	−.022*	.271+	.265+	.268+
	(.441)	(.458)	(.010)	(.010)	(.010)	(.144)	(.145)	(.145)
CEO age	.000	.002	−.000	−.000	−.000	−.008	−.008	−.008
	(.020)	(.020)	(.000)	(.000)	(.000)	(.006)	(.006)	(.006)
CEO compensation	.267	.272+	−.004	−.004	−.004	−.021	−.018	−.009
	(.162)	(.155)	(.003)	(.003)	(.003)	(.047)	(.047)	(.048)
CEO tenure	−.041	−.039	−.000	−.000	−.000	.014	.013	.012
	(.039)	(.036)	(.001)	(.001)	(.001)	(.011)	(.011)	(.011)
Operational efficiency	−2.625***	−2.636***	−.010	−.010	−.007	.007	.011	−.036
	(.343)	(.370)	(.008)	(.008)	(.008)	(.115)	(.114)	(.118)
Capital intensity	−5.323	−5.031	.128	.134	.141	.362	.353	.240
	(6.129)	(6.007)	(.131)	(.131)	(.130)	(1.843)	(1.842)	(1.840)
Precrisis stock price	.062***	.061***	.001***	.001***	.001***	.012***	.012***	.013***
	(.016)	(.010)	(.000)	(.000)	(.000)	(.003)	(.003)	(.003)
Environmental dynamism	5.739	5.625	.320***	.318***	.310***	−1.554	−1.519	−1.593
	(5.411)	(3.503)	(.076)	(.076)	(.076)	(1.103)	(1.104)	(1.106)
Environmental munificence	.830	.778	.060+	.059	.058	.886+	.885+	.825
	(2.151)	(1.654)	(.036)	(.036)	(.036)	(.530)	(.530)	(.534)
State ownership	.100	.135	−.016*	−.015*	−.015*	.006	.003	.003
	(.314)	(.325)	(.007)	(.007)	(.007)	(.105)	(.105)	(.105)

Table 16 (continued)

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Military CEO		−2.230*		−.049*	−.046*		.555+	.537+
		(.918)		(.020)	(.020)		(.284)	(.285)
Pre-shock Risk taking (R&D)					.001*			−.014+
					(.001)			(.008)
Industry	Included	Included	Included	Included	Included	Included	Included	Included
N	1033	1033	1033	1033	1033	26,286	26,286	26,286

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 17 Robust test: effects of firms' per-shock risk taking on organizational resilience based on the alternative measure for organizational resilience (Financial Volatility)

	Organizational resilience (Financial volatility)	
	Model 1	Model 2
LEV	.030+	.031+
	(.016)	(.016)
Size	.001	.001
	(.004)	(.004)
List age	−.000	−.002
	(.005)	(.005)
Growth	−.011	−.010
	(.013)	(.013)
CEO duality	−.004	−.005
	(.004)	(.004)
Independent directors	−.019	−.016
	(.033)	(.033)
Female directors	.018	.018
	(.015)	(.015)
Slack resources	−.000	−.001
	(.001)	(.001)
ROA	−.145***	−.110**
	(.036)	(.036)
PPE	.035+	.030
	(.019)	(.019)
CAP	−.004	−.003
	(.004)	(.004)
Ownership	−.001	−.002
	(.007)	(.007)
CEO gender	.002	.002
	(.007)	(.007)
CEO age	−.000	−.000
	(.000)	(.000)
CEO compensation	.001	.000
	(.003)	(.003)
CEO tenure	.000	.001
	(.001)	(.001)
Operational efficiency	−.013*	−.014*
	(.006)	(.006)
Capital intensity	.077	.076
	(.106)	(.106)
Precrisis stock price	.001***	.001***
	(.000)	(.000)
Environmental dynamism	−.050	−.082
	(.051)	(.054)

Table 17 (continued)

	Organizational resilience (Financial volatility)	
	Model 1	Model 2
Environmental munificence	.029	.025
	(.025)	(.025)
State ownership	−.008	−.006
	(.005)	(.005)
Pre-shock risk taking		.108*
		(.049)
Industry	Included	Included
N	1033	1033

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

expected, the results show that CEOs' military experience is positively related to organizational resilience, and firms' risk taking before a shock mediates the relationship between CEOs' military experience and organizational resilience. These findings present important implications for business management, organizational responsiveness, and the corporate financial consequences to the shock.

Theoretical implications

This study offers several important theoretical implications. **First**, we contribute to the literature on organizational resilience by exploring new sets of antecedents. Previous developments in the literature on organizational resilience focus on two aspects. The first aspect examines the influence of firm-level factors on organizational resilience, such as positive relationships (Gittell et al., 2006), frugal corporate culture (Kachaner et al., 2012), and social and environmental practices (Desjardine et al., 2019). The second aspect theorizes the impact of individual-level factors on organizational resilience, such as such as employees' cognitions, skills and abilities, behaviors, and self-regulatory processes (Branicki et al., 2019; Lengnick-Hall et al., 2011; Luthans et al., 2007). However, researchers' knowledge about how top executive' individual characteristics affect organizational resilience is limited. Despite a few efforts that focus on the effect of CEO psychological traits on firm resilience (Buyl et al., 2019; Sajko et al., 2020), little is known about the influence of CEO experiences. Thus, this study enriches literature by providing the first attempt to establish a link between CEOs with military experience and organizational resilience in a shock. In particular, we emphasize that CEOs with military experience not only affect the stability of the company, but also its flexibility following the shock.

Table 18 Robust test: regression analysis of the mediating effect based on the alternative measure for organizational resilience (Financial Volatility)

	Pre-shock risk taking		Organizational resilience (Financial volatility)		
	Model 1	Model 2	Model 3	Model 4	Model 5
LEV	−.007	−.007	.030+	.031+	.031+
	(.014)	(.014)	(.016)	(.016)	(.016)
Size	.001	.001	.001	.001	.001
	(.003)	(.003)	(.004)	(.004)	(.004)
List age	.015**	.015**	−.000	−.001	−.002
	(.005)	(.005)	(.005)	(.005)	(.005)
Growth	−.016	−.016	−.011	−.012	−.010
	(.013)	(.013)	(.013)	(.013)	(.013)
CEO duality	.004	.004	−.004	−.004	−.005
	(.003)	(.003)	(.004)	(.004)	(.004)
Independent directors	−.030	−.032	−.019	−.022	−.019
	(.026)	(.026)	(.033)	(.033)	(.033)
Female directors	.005	.005	.018	.018	.018
	(.012)	(.012)	(.015)	(.015)	(.015)
Slack resources	.001	.001	−.000	−.000	−.000
	(.001)	(.001)	(.001)	(.001)	(.001)
ROA	−.330***	−.331***	−.145***	−.147***	−.112**
	(.050)	(.050)	(.036)	(.036)	(.036)
PPE	.047**	.047**	.035+	.034+	.030
	(.018)	(.018)	(.019)	(.019)	(.019)
CAP	−.002	−.002	−.004	−.004	−.003
	(.003)	(.003)	(.004)	(.004)	(.004)
Ownership	.004	.004	−.001	−.002	−.002
	(.005)	(.005)	(.007)	(.007)	(.007)
CEO gender	.002	.002	.002	.002	.002
	(.005)	(.005)	(.007)	(.007)	(.007)
CEO age	−.000	.000	−.000	−.000	−.000
	(.000)	(.000)	(.000)	(.000)	(.000)
CEO compensation	.006***	.006***	.001	.001	.000
	(.002)	(.002)	(.003)	(.003)	(.003)
CEO tenure	−.001	−.001	.000	.001	.001
	(.000)	(.000)	(.001)	(.001)	(.001)
Operational efficiency	.009	.009	−.013*	−.014*	−.014*
	(.006)	(.006)	(.006)	(.006)	(.006)
Capital intensity	.010	.015	.077	.082	.081
	(.083)	(.084)	(.106)	(.105)	(.105)
Precrisis stock price	.000*	.000*	.001***	.001***	.001***
	(.000)	(.000)	(.000)	(.000)	(.000)

Table 18 (continued)

	Pre-shock risk taking		Organizational resilience (Financial volatility)		
	Model 1	Model 2	Model 3	Model 4	Model 5
Environmental dynamism	.297***	.298***	−.050	−.049	−.080
	(.052)	(.052)	(.051)	(.051)	(.054)
Environmental munificence	.033	.033	.029	.029	.025
	(.025)	(.025)	(.025)	(.025)	(.025)
State ownership	−.017***	−.017***	−.008	−.007	−.006
	(.004)	(.004)	(.005)	(.005)	(.005)
Military CEO		−.026**		−.029*	−.027*
		(.009)		(.013)	(.013)
Pre-shock risk taking					.103*
					(.049)
Industry	Included	Included	Included	Included	Included
N	1033	1033	1033	1033	1033

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Second, by demonstrating the impact of CEO military on firm resilience, we enrich the literature regarding consequences of military leadership in the context of exogenous shocks. Previous studies have found that, in normal times, CEO military experience can affect firm performance, financial policies, or investment decisions (Koch-Bayram & Wernicke, 2018; Benmelech & Frydman, 2015; Luo et al., 2017; Malmendier et al., 2011). However, as exogenous shocks (such as natural disasters, pandemics, terrorist attacks, and economic crises) are sudden changes that can dramatically affect individuals, organizations, and societies (Meyer, 1982; Ramey, 2016), organizations will inevitably be exposed to a variety of threats and hazards of destructive events. Effective response and recovery processes are crucial to deal with these events. Unlike nearly all of the prior studies that focus on how CEO military experience affects business decisions in normal times, this study enriches the relevant research by providing the first attempt to connect the CEO military experience and organizational resilience to exogenous shocks. Focusing on the period during the COVID-19 pandemic shock, this research highlights the crucial role that military CEOs play in helping firms shape resilience in the context of exogenous shocks.

Finally, we contribute to leadership literature and upper echelons theory by opening the "black box" of CEO military experience and organizational resilience by means of firms' pre-shock risk taking. In strategic management studies, researchers have sought linkages between CEO military experience and corporate strategic decisions (e.g.,

Table 19 Robust test: effects of firms' per-shock risk taking on organizational resilience in six-month window

	Stability (Severity of loss)	Stability (Severity of loss)	Flexibility (Time to recovery)	Flexibility (Time to recovery)
	Model 1	Model 2	Model 3	Model 4
LEV	.065*	.066*	−.429*	−.439*
	(.032)	(.032)	(.183)	(.182)
Size	−.007	−.008	.144***	.143***
	(.007)	(.007)	(.039)	(.038)
List age	.002	−.001	−.008	.003
	(.010)	(.010)	(.055)	(.055)
Growth	−.038+	−.035	.030	.003
	(.023)	(.023)	(.139)	(.140)
CEO duality	.007	.006	−.128**	−.129**
	(.008)	(.008)	(.047)	(.046)
Independent directors	−.065	−.059	−.606	−.661
	(.060)	(.060)	(.402)	(.403)
Female directors	−.007	−.009	−.119	−.087
	(.028)	(.028)	(.163)	(.161)
Slack resources	.000	.000	−.014	−.014
	(.003)	(.003)	(.015)	(.015)
ROA	−.192*	−.133	2.019***	1.489**
	(.091)	(.093)	(.469)	(.544)
PPE	.005	−.002	.132	.132
	(.031)	(.031)	(.157)	(.160)
CAP	.005	.005	.016	.013
	(.005)	(.005)	(.031)	(.031)
Ownership	.016	.015	−.003	.019
	(.013)	(.013)	(.079)	(.070)
CEO gender	−.034*	−.034*	.080	.068
	(.014)	(.014)	(.081)	(.079)
CEO age	−.000	−.000	−.005+	−.005
	(.001)	(.001)	(.003)	(.003)
CEO compensation	−.007+	−.008+	−.017	−.010
	(.004)	(.004)	(.023)	(.023)
CEO tenure	−.001	−.001	.002	.001
	(.001)	(.001)	(.006)	(.006)
Operational efficiency	−.010	−.012	.076	.091
	(.009)	(.009)	(.059)	(.058)
Capital intensity	−.040	−.046	−.746	−.630
	(.166)	(.163)	(.914)	(.911)
Precrisis stock price	.000	.000	−.004*	−.004*
	(.000)	(.000)	(.002)	(.002)
Environmental dynamism	.543***	.492***	−.971+	−.647
	(.116)	(.118)	(.533)	(.558)

Table 19 (continued)

	Stability (Severity of loss) Model 1	Stability (Severity of loss) Model 2	Flexibility (Time to recovery) Model 3	Flexibility (Time to recovery) Model 4
Environmental munificence	.003	−.003	.005	.060
	(.047)	(.046)	(.273)	(.271)
State ownership	−.008	−.005	.052	.041
	(.009)	(.009)	(.050)	(.051)
Pre-shock risk taking		.175*		−1.062+
		(.087)		(.607)
Industry	Included	Included	Included	Included
N	1030	1030	3159	3159

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

corporate philanthropy, and financial policies; Koch-Bayram & Wernicke, 2018; Malmendier et al., 2011; Luo et al., 2017). The leadership literature also presents empirical evidence of the effect of military leaders on performance (e.g., Hedlund et al., 2003). However, nearly all of them neglect to unveil its underlying mechanism. The present findings confirm that firms' pre-shock risk taking play a mediating role between CEOs with military experience and organizational resilience. By examining CEOs' experiences and the mediating mechanism through which they influence strategic outcomes, we respond to the call for studies to address the black box of CEOs' experiences and continue to refine the theoretical and empirical links between CEOs' experiences and strategic outcome (Hambrick, 2007).

Practical implications

This study offers important practical implications for research in practice diffusion. **First**, human beings always face different kinds of risks, including water and food crises, extreme weather events, terrorist attacks, cybercrime, financial crises, and, most recently, the COVID-19 pandemic. The quest of organizational resilience has taken on new urgency during the shocks as the complexity and severity of shocks impact is unprecedented. Therefore, to obtain higher degree of organizational resilience to deal with the shocks, the board must consider the characteristics of candidates for top managerial positions. The results show that, if the board hopes for the firm to rebound back from the shock, then hiring a CEO candidate with military experience is imperative.

Table 20 Robust test: regression analysis of the mediating in six-month window

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
LEV	−.007	−.007	.065*	.066*	.067*	−.429*	−.431*	−.441*
	(.014)	(.014)	(.032)	(.032)	(.032)	(.183)	(.183)	(.182)
Size	.002	.002	−.007	−.007	−.007	.144***	.143***	.142***
	(.003)	(.003)	(.007)	(.007)	(.007)	(.039)	(.039)	(.039)
List age	.016**	.016**	.002	.001	−.002	−.008	−.003	.008
	(.005)	(.005)	(.010)	(.010)	(.010)	(.055)	(.055)	(.055)
Growth	−.017	−.017	−.038+	−.039+	−.036	.030	.033	.006
	(.013)	(.013)	(.023)	(.023)	(.023)	(.139)	(.139)	(.140)
CEO duality	.005	.005	.007	.007	.006	−.128**	−.130**	−.130**
	(.004)	(.004)	(.008)	(.008)	(.008)	(.047)	(.047)	(.046)
Independent directors	−.031	−.034	−.065	−.070	−.064	−.606	−.558	−.614
	(.026)	(.026)	(.060)	(.060)	(.060)	(.402)	(.402)	(.402)
Female directors	.009	.009	−.007	−.007	−.009	−.119	−.134	−.102
	(.013)	(.013)	(.028)	(.028)	(.028)	(.163)	(.163)	(.161)
Slack resources	.001	.001	.000	.001	.001	−.014	−.016	−.016
	(.001)	(.001)	(.003)	(.003)	(.003)	(.015)	(.015)	(.015)
ROA	−.333***	−.334***	−.192*	−.194*	−.138	2.019***	2.026***	1.501**
	(.050)	(.050)	(.091)	(.091)	(.093)	(.469)	(.470)	(.545)
PPE	.043*	.042*	.005	.004	−.003	.132	.144	.144
	(.018)	(.018)	(.031)	(.031)	(.031)	(.157)	(.157)	(.160)
CAP	−.003	−.003	.005	.005	.005	.016	.016	.013
	(.003)	(.003)	(.005)	(.005)	(.005)	(.031)	(.032)	(.031)
Ownership	.005	.004	.016	.015	.015	−.003	.004	.025
	(.005)	(.005)	(.013)	(.013)	(.013)	(.079)	(.079)	(.070)
CEO gender	.003	.003	−.034*	−.033*	−.034*	.080	.078	.065
	(.005)	(.005)	(.014)	(.014)	(.014)	(.081)	(.081)	(.079)
CEO age	.000	.000	−.000	−.000	−.000	−.005+	−.005+	−.005+
	(.000)	(.000)	(.001)	(.001)	(.001)	(.003)	(.003)	(.003)
CEO compensation	.006**	.006**	−.007+	−.007+	−.008+	−.017	−.016	−.009
	(.002)	(.002)	(.004)	(.004)	(.004)	(.023)	(.023)	(.023)
CEO tenure	−.001+	−.001+	−.001	−.001	−.001	.002	.001	.000
	(.000)	(.000)	(.001)	(.001)	(.001)	(.006)	(.006)	(.006)
Operational efficiency	.008	.008	−.010	−.010	−.012	.076	.075	.089
	(.006)	(.006)	(.009)	(.009)	(.010)	(.059)	(.059)	(.058)
Capital intensity	.036	.041	−.040	−.028	−.035	−.746	−.838	−.723
	(.086)	(.087)	(.166)	(.165)	(.162)	(.914)	(.912)	(.910)
Precrisis stock price	.000*	.000*	.000	.000	.000	−.004*	−.004*	−.004*
	(.000)	(.000)	(.000)	(.000)	(.000)	(.002)	(.002)	(.002)
Environmental dynamism	.292***	.293***	.543***	.545***	.496***	−.971+	−.972+	−.652
	(.052)	(.052)	(.116)	(.116)	(.118)	(.533)	(.532)	(.557)

Table 20 (continued)

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Environmental munificence	.038	.038	.003	.004	−.002	.005	−.007	.047
	(.025)	(.025)	(.047)	(.047)	(.046)	(.273)	(.274)	(.271)
State ownership	−.017***	−.017***	−.008	−.007	−.004	.052	.044	.033
	(.004)	(.004)	(.009)	(.009)	(.009)	(.050)	(.050)	(.051)
Military CEO		−.026**		−.051**	−.047*		.328***	.321***
		(.009)		(.020)	(.020)		(.080)	(.082)
Pre-shock Risk taking					.168+			−1.052+
					(.087)			(.608)
Industry	Included	Included	Included	Included	Included	Included	Included	Included
N	1030	1030	1030	1030	1030	3159	3159	3159

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 21 Robust test: effects of firms' per-shock risk taking on organizational resilience in one-year window

	Stability (Severity of loss)	Stability (Severity of loss)	Flexibility (Time to recovery)	Flexibility (Time to recovery)
	Model 1	Model 2	Model 3	Model 4
LEV	.088*	.089*	−.440*	−.450*
	(.039)	(.039)	(.184)	(.183)
Size	−.006	−.006	.145***	.144***
	(.008)	(.008)	(.039)	(.039)
List age	.011	.008	−.007	.004
	(.012)	(.012)	(.056)	(.056)
Growth	−.056+	−.053+	.029	.001
	(.029)	(.029)	(.140)	(.140)
CEO duality	.004	.003	−.127**	−.127**
	(.009)	(.009)	(.047)	(.046)
Independent directors	−.055	−.050	−.588	−.648
	(.067)	(.067)	(.403)	(.403)
Female directors	.013	.012	−.115	−.081
	(.034)	(.034)	(.164)	(.162)
Slack resources	.001	.001	−.013	−.013
	(.003)	(.003)	(.014)	(.014)
ROA	−.190*	−.132	2.011***	1.452**
	(.094)	(.100)	(.477)	(.548)
PPE	−.001	−.009	.126	.126
	(.035)	(.035)	(.158)	(.161)

Table 21 (continued)

	Stability (Severity of loss) Model 1	Stability (Severity of loss) Model 2	Flexibility (Time to recovery) Model 3	Flexibility (Time to recovery) Model 4
CAP	−.001	−.001	.017	.013
	(.006)	(.006)	(.032)	(.031)
Ownership	.024	.024	−.006	.017
	(.016)	(.016)	(.079)	(.070)
CEO gender	−.041*	−.042*	.089	.076
	(.017)	(.017)	(.082)	(.080)
CEO age	−.000	−.000	−.005+	−.005
	(.001)	(.001)	(.003)	(.003)
CEO compensation	−.008+	−.009+	−.016	−.009
	(.005)	(.005)	(.023)	(.023)
CEO tenure	−.002+	−.002+	.001	.001
	(.001)	(.001)	(.006)	(.006)
Operational efficiency	−.020+	−.021+	.075	.090
	(.012)	(.012)	(.059)	(.058)
Capital intensity	.099	.093	−.758	−.634
	(.206)	(.205)	(.916)	(.913)
Precrisis stock price	.001+	.001	−.004*	−.004*
	(.000)	(.000)	(.002)	(.002)
Environmental dynamism	.604***	.552***	−.991+	−.650
	(.140)	(.143)	(.530)	(.558)
Environmental munificence	.041	.035	.023	.080
	(.056)	(.056)	(.276)	(.273)
State ownership	−.008	−.005	.055	.043
	(.011)	(.011)	(.050)	(.050)
Pre-shock risk taking		.175+		−1.122+
		(.105)		(.608)
Industry	Included	Included	Included	Included
N	1030	1030	3907	3907

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Second, despite the debate on whether firms should engage in risk taking (Hirshleifer et al., 2012; Hoskisson et al., 2017; Troy et al., 2011), this study suggests that firms' pre-shock risk taking can damage organizational resilience. Given that firms are inevitably affected by various kinds of threats and risks, military executives should reduce both short- and long-term negative impacts by maintaining a more rigorous risk-taking strategy.

Table 22 Robust test: regression analysis of the mediating in one-year window

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
LEV	−.007	−.007	.088*	.089*	.090*	−.440*	−.442*	−.452*
	(.014)	(.014)	(.039)	(.038)	(.038)	(.184)	(.184)	(.183)
Size	.002	.002	−.006	−.005	−.006	.145***	.144***	.144***
	(.003)	(.003)	(.008)	(.008)	(.008)	(.039)	(.039)	(.039)
List age	.016**	.016**	.011	.010	.007	−.007	−.002	.010
	(.005)	(.005)	(.012)	(.012)	(.012)	(.056)	(.056)	(.056)
Growth	−.017	−.017	−.056+	−.057+	−.054+	.029	.031	.004
	(.013)	(.013)	(.029)	(.029)	(.029)	(.140)	(.140)	(.140)
CEO duality	.005	.005	.004	.004	.003	−.127**	−.128**	−.129**
	(.004)	(.004)	(.009)	(.009)	(.009)	(.047)	(.047)	(.046)
Independent directors	−.031	−.034	−.055	−.062	−.056	−.588	−.541	−.602
	(.026)	(.026)	(.067)	(.067)	(.067)	(.403)	(.402)	(.403)
Female directors	.009	.009	.013	.013	.012	−.115	−.129	−.096
	(.013)	(.013)	(.034)	(.034)	(.034)	(.164)	(.164)	(.162)
Slack resources	.001	.001	.001	.002	.002	−.013	−.014	−.014
	(.001)	(.001)	(.003)	(.003)	(.003)	(.014)	(.014)	(.014)
ROA	−.333***	−.334***	−.190*	−.193*	−.138	2.011***	2.017***	1.464**
	(.050)	(.050)	(.094)	(.094)	(.100)	(.477)	(.478)	(.549)
PPE	.043*	.042*	−.001	−.003	−.010	.126	.138	.138
	(.018)	(.018)	(.035)	(.035)	(.035)	(.158)	(.158)	(.161)
CAP	−.003	−.003	−.001	−.001	−.001	.017	.017	.013
	(.003)	(.003)	(.006)	(.006)	(.006)	(.032)	(.032)	(.031)
Ownership	.005	.004	.024	.023	.023	−.006	.000	.023
	(.005)	(.005)	(.016)	(.016)	(.016)	(.079)	(.079)	(.071)
CEO gender	.003	.003	−.041*	−.041*	−.041*	.089	.087	.074
	(.005)	(.005)	(.017)	(.017)	(.017)	(.082)	(.083)	(.081)
CEO age	.000	.000	−.000	−.000	−.000	−.005+	−.006+	−.005
	(.000)	(.000)	(.001)	(.001)	(.001)	(.003)	(.003)	(.003)
CEO compensation	.006**	.006**	−.008+	−.008+	−.009+	−.016	−.015	−.008
	(.002)	(.002)	(.005)	(.005)	(.005)	(.023)	(.023)	(.023)
CEO tenure	−.001+	−.001+	−.002+	−.002+	−.002+	.001	.001	.000
	(.000)	(.000)	(.001)	(.001)	(.001)	(.006)	(.006)	(.006)
Operational efficiency	.008	.008	−.020+	−.020+	−.021+	.075	.074	.089
	(.006)	(.006)	(.012)	(.012)	(.012)	(.059)	(.060)	(.058)
Capital intensity	.036	.041	.099	.115	.108	−.758	−.850	−.725
	(.086)	(.087)	(.206)	(.205)	(.204)	(.916)	(.914)	(.911)
Precrisis stock price	.000*	.000*	.001+	.001	.001	−.004*	−.004*	−.004*
	(.000)	(.000)	(.000)	(.000)	(.000)	(.002)	(.002)	(.002)
Environmental dynamism	.292***	.293***	.604***	.606***	.558***	−.991+	−.993+	−.655
	(.052)	(.052)	(.140)	(.140)	(.143)	(.530)	(.529)	(.557)
Environmental munificence	.038	.038	.041	.043	.036	.023	.011	.067
	(.025)	(.025)	(.056)	(.056)	(.056)	(.276)	(.276)	(.273)

Table 22 (continued)

	Pre-shock risk taking		Stability (Severity of loss)			Flexibility (Time to recovery)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
State ownership	−.017***	−.017***	−.008	−.007	−.004	.055	.047	.035
	(.004)	(.004)	(.011)	(.011)	(.011)	(.050)	(.050)	(.050)
Military CEO		−.026**		−.068***	−.063**		.324***	.316***
		(.009)		(.020)	(.020)		(.081)	(.083)
Pre-shock Risk taking					.165			−1.113+
					(.106)			(.608)
Industry	Included	Included	Included	Included	Included	Included	Included	Included
N	1030	1030	1030	1030	1030	3907	3907	3907

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Limitations and future research directions

Akin to other studies, this study has several limitations. **First**, while our study has found that the military experience of CEOs can influence organizational resilience, alternative antecedents to organizational resilience, such as characteristics of the chairman, board of directors, top management team, middle managers, or employees, can also be considered. Future research can focus on these issues and further broaden the understanding of firms' recovery from crisis. **Second**, while we focus on military CEOs' personality traits such as being risk-averse, uncertain, and self-sacrificing, which would lead them to engage in less risky strategies. Considering that there are two different perspectives on the risk preferences of military CEOs, future research can further develop this type of study by proposing two competing hypotheses that examine how military CEOs influence firm risk-taking. **Third,** although we focused on the impact of CEO military experience on firm resilience in "crisis time" in this study, the relationship between CEO military experience and organizational resilience in "normal times" is also of great interest. Future research can focus on the influence of CEO military experiences on organizational resilience in "normal times". **Finally**, although our study focused on organizational resilience via two dimensions based on stock price data measurements in crisis times, it is also important to focus on measures of organizational resilience that reflect its inherent nature. Future research can focus on these measures of organizational resilience that reflect its inherent nature in normal times, such as a firm's growth over the long term.

Conclusion

In this study, we examine how CEOs with military experience affect firms' pre-shock risk taking and thus organizational resilience to shocks. We find that CEOs with military experience are less likely to engage in their firm's pre-shock risk

Table 23 Supplementary Analyses: effects of firms' risk taking on slack resources before the shock

	Model 1	Model 2
Size	−.548***	−.547***
	(.041)	(.041)
List age	−.503***	−.497***
	(.115)	(.116)
Growth	−.375***	−.375***
	(.113)	(.113)
CEO duality	.103	.104
	(.091)	(.091)
Independent directors	.205	.220
	(.655)	(.655)
Female directors	−.146	−.150
	(.316)	(.317)
ROA	5.937***	5.928***
	(.730)	(.730)
PPE	−3.131***	−3.130***
	(.296)	(.296)
Ownership	.443***	.444***
	(.130)	(.130)
Environmental dynamism	1.209	1.209
	(.868)	(.867)
State ownership	.020	.015
	(.087)	(.087)
CEO gender	.371***	.372***
	(.096)	(.096)
CEO age	.008	.008
	(.006)	(.006)
CEO tenure	.030**	.029*
	(.011)	(.011)
Pre-shock risk taking		−.034*
		(.015)
Industry	Included	Included
Year	Included	Included
N	2615	2615

Standard errors in parentheses; + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

taking. In turn, a low level of firms' pre-shock risk taking is associated with a high level of organizational resilience following a shock. Overall, we determine that firms' pre-shock risk taking partially mediates the relationship between CEOs with military experience and firms' organizational resilience to shocks. Thus, our study advances the research agenda of how CEO characteristics affect corporate outcomes related to exogenous shocks.

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Data Availability The data that support the fndings of this study are available from the authors on reasonable request.

Declarations

Conflict of interest Author Zhe Zhang declares that she has no conflict of interest. Author Xin Wang declares that she has no conflict of interest. Author Ming Jia declares that he has no conflict of interest. The work described was original research that has not been published previously, and not under consideration for publication elsewhere, in whole or in part. All the authors listed have approved the manuscript that is enclosed.

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