The role of social capital on proactive and reactive resilience of organizations post-disaster

Abstract

With disruptive events of higher magnitudes increasing globally, building resilience has become a priority for many organizations. Existing studies have prioritized the contribution of internal factors to building organizational resilience. This study examines social capital emanating from supply chain partners as an external factor building organizational resilience. Using social capital theory, we develop a conceptual model that postulates three dimensions of social capital (cognitive, structural and relational) as antecedents of both proactive and reactive organizational resilience. The model is tested on a sample of Chinese firms that survived the 2008 Sichuan earthquake. The findings show that not all facets of social capital contribute to the development of organizational resilience. While stronger structural capital improves proactive organizational resilience, relational capital only improves reactive organizational resilience. The findings have both theoretical and managerial implications for post-disaster resilience building.

Keywords: Social capital; organizational resilience; post-disaster; reactive resilience; proactive resilience.

1. Introduction

In today's business environment, organizations face disruptive events that threatens their functions and performance [113]. With disrutive events of higher magnitude rising globally [113], researchers have sought to explain both the nature and impact of disruptive events on organizations. Accordingly, studies have examined how organizations can effectively prepare for, respond to, and overcome disruptive events [100, 103]. In particular, studies have examined how organizations develop resilience in response to disruptive events and the mitigation strategies employed [108, 114].

Research on organizational resilience attempts not only to understand what is resilience but also how and why some organizations are more resilient than others [30, 113]. Factors such as leadership, supply chain management, employee engagment, breaking down sillos, and

disaster planning, among others, are purported to build organizational resilience [98]. These factors can be understood within the broader context of institutional, cultural and organizational norms and structures as suggested in previous studies [84] and dependent on governance regimes and development pathways [33]. However, the focus of this study is not on these broader factors but rather geared towards understanding supply chain issues and organizational resilience. There is no consensus on either the definition or the factors that contribute to organizational resilience. We address these by: (i) conducting a comprehensive review of existing definitions (see appendix A) to higlight inconsistencies; (ii) we review the factors (internal and external) that build organizational resilience (see Appendix B) to identify knowledge gaps.

From these reviews, we find that most studies use the disaster life cycle as the theoretical lens to understand resilience, implying that definitions of organizational resilience tend to have an emphasis on response and recovery from unexpected disruptions [see 7, 103] with little focus on organizational preparedness aspects. Recent studies [see 6, 56] identify the importance of preparedness or preventive capabilities in tandem with reactive capabilities for business recovery purposes. As such, an understanding of both proactive and reactive capabilities is necessary for building organizational resilience. Yet, these capabilities can also be viewed in relation to broader organizational change iniatives following a disaster [41]. We define organizational resilience as an organization's ability not only to develop preventive capacity to face any unexpected disruptions (i.e. proactive aspect) but also to take the necessary and quick actions to respond and recover from that disruption (reactive aspect) to ensure business continuity.

The extensive review of internal and external factors that contribute to build organizational resilience (see Appendix B) reveals both conceptual [see 4, 15, 61] and empirical studies [see 13, 71]. Yet, which internal and/or external factors are more important

and the role of external factors in developing organizational resilience remain elusive. External factors such as cooperation [90], relational behaviour [13], and partnership [67] have received scant attention in this literature. However, the importance placed by firms on internal versus external factors is dependent organizational culture, values and systems [12]. Given the knowledge gaps identified previously, the main objective of this study is to examine the role of social capital emanating from supply chain partners as an external factor that builds organizational resilience (i.e. proactive and reactive). Drawing on social capital theory (SCT) [3], we argue that networks and resources available to firms through their connections to others contribute to more resilient organizations [3, 98]. We test this proposition in the post quake context of Wenchuan County in the Sichuan Province of China, arguing that social capital facilitates recovery, with faster recovery linked to stronger social capital [3]. In the disaster risk reduction literature, it is widely acknowledged that social capital plays a critical role in reducing disaster risk and facilitates recovery at the community level [72]. Particularly, Aldrich [2] argues that social capital is, "the strongest and most robust predictor of recovery after a catastrophe".

The contributions of this study are three-fold. First, while Chowdhury et al.'s [20] study focuses on the role of social capital emanating from upstream supply chain partners (i.e. key suppliers) to build adaptive resilience, this study considers both upstream and downstream supply chain partners. Thus, a more comprehensive view of the social capital emanating from supply chain partners is offered in a post disaster context to build both proactive and reactive aspects of organizational resilience . Second, this study responds to the call for an examination of social capital as an external factor that builds reactive organizational resilience [e.g. 87]. Third, despite the importance of disaster preparedness for quick response being highlighted in previous studies [11], this relationship between proactive and reactive organizational resilience

remains untested in a post-disaster context. The findings have implications for building organizational culture and resilience post-disaster.

Next, the theoretical framework and hypothesis development sections are presented followed by the method, results and their implications. The paper concludes with the limitations of the study that give rise to areas of further research.

2. Theoretical framework and Hypothesis Development

2.1 Organizational resilience

Resilience as a concept originates from the field of ecology and has been defined as the capacity of a system to absorb change, while persisting development in the original state subject to disturbances and changing conditions [47]. The disciplinary reach of resilience across the natural and social sciences reflect its strength in application but it also shows that resilience holds different meaning across discipline [27, 65]. While in the engineering field, for example, resilience refers to the ability of structures to withstand significant environmental perturbations [48], in the psychology field resilience implies the ability for individuals to cope with, adapt to and bounce back from adversity [57]. Researchers have cautioned against the simplistic transfer of an ecological systems concept into social science research [41].

In management and organizational studies literature, the notion of resilience is usually associated with an organization's survival in the face of unexpected change [41] with recent studies suggesting that notions of recovery time, ability, and costs must also be considered [4, 26, 42]. Hence, organizational resilience refers to " the incremental capacity of an organization to anticipate and adjust to the environment" [80]. It is a dynamic attribute that organizations possess or not, developed through a set of capabilities that emerge from observing and correcting for maladaptive tendencies related to disruptive events [36, 80, 103]. Appendix A reviews 33 definitions of organizational resilience from 1997 to 2019 and the result shows

inconsistencies across studies in defining the term. One commonality across definitions is the focus on "reactive aspects" of resilience, implying an emphasis on the firm's response to and its ability to "bounce back" from disruptive events [103]. Given the importance of "proactive aspects" of resilience for business continuity, researchers have called for the simultaneous examinination of proactive (active) and reactive (passive) aspects of resilience [6].

In the extant organizational resilience literature, two streams of studies can be identified (see Appendix B). The first [e.g. 26, 38, 49, 50] considers resilience as a desired organizational characteristic reflected by several attributes (e.g., strong leadership, engaged staff, and ability to take decisions quickly) and therefore focuses on the process of building resilience. Most of these studies are theoretical or conceptual with limited empirical evidence. The second stream [e.g. 20, 70, 80, 81, 82, 106] mainly considers resilience as an outcome and empirically identifies its determinants , thereby suggesting that some organizations are resilient while others are not. Studies in this group mainly emphasise two key aspects – the measurement of organizational resilience [59, 71] and the identification of practices that build organizational resilience [20, 81, 106]. Our study falls under the latter category in an attempt to develop a common understanding of organizational resilience through examining both its proactive and reactive aspects, and this is discussed next.

2.1.1 Proactive organizational resilience

Proactive organizational resilience refers to the act of anticipation and active waiting [102] for building an organization's readiness for change [37] as suggested in previous studies [11, 21, 22, 59]. In the supply chain context, Bode and Macdonald [11] define readiness as " the culmination of a process of self-assessment and preparation for supply chain risks resulting in the ability to decisively react to risks as they manifest". Proactive resilience is built on four key organizational activities– awareness of potential disruptions [11, 68, 71], potential impact self-assessment [11, 71], self-improvement for prevention capabilities [11, 66], and

engagement related to planning and preparing for emergency situations [11, 59]. These proactive aspects may be facilitated or hindered by existing power, agency of individual actors, and internal/external structures in place [84].

2.1.2 Reactive organizational resilience

To respond and bounce back from unexpected events, firms need to understand the extent to which previous information (i.e., information gathered prior to the disruptive event) can be applied to the current situation [11, 29]. A firm's ability to quickly gather and interpret relevant information can lower the impact of a disruptive event [11]. However, as previous studies indicate, firm size, existing relationships and structures have to be taken into consideration to understand adaptive capabilities of organizations [18]. In this study, reactive organizational resilience is assessed on five key activities related to disruptions – quick recognition; fast gathering and diagnosis of information [11]; rapid development of a set of reactions [11]; ability to quickly organize a formal response team [85]; and success in dealing with the disruption [85].

2.2 Social capital and its dimensions

The enabling role of social capital in building individual and community resilience post-disaster has been recognized in previous studies [3, 51, 72, 94], but the relationship between social capital and organizational resilience is under-researched [20]. Doerfel, Lai, and Chewning [28] argued that in the face of unprecedented crisis, firms can rely on established relationships to help with recovery. Social capital resides in relationships that are created through exchange, providing access to resources [73]. Social capital, therefore, offers a theoretical perspective for examining the advantage gained by firms through social networks [18]. There are two main categorizations of social capital. The first is based on the network perspective, which defines social capital using concepts of bonding, bridging and linking [104,

115]. The other is based on the social structure perspective, which defines social capital using structural, relational, and cognitive capital [73]. Given that our study focuses on the social structure of relationships among supply chain partners (e.g., suppliers or customers), the categorization provided by Nahapiet and Ghoshal [73] is more appropriate. It must be acknowledged, however, that not all firms may use social capital in the disaster response and recovery process [41]. Next, structural, relational and cognitive dimensions of social capital are discussed.

Structural capital refers to the configuration of linkages between people across organizations, that is, who you reach and how you reach them [16, 73]. It is related to the impersonal configuration of linkages within a social structure [73] and can be assessed from the perspective of social ties [53, 109]. These social ties can potentially provide access to valuable information [24]. Studies suggest that structural capital among partnering firms create a structure with dense interactions (i.e., a high frequency of interactions among partners) and multiple connections that facilitates the exchange of more reliable and diverse information [17, 55, 109]. Using dense interactions, information is more readily accessible and can therefore be available early as part of a warning system [16]. Multiple connections (i.e., interactions among diverse points of contact) can help partner firms to design a structure with different contact points within and across different levels of the firm [109]. *Cognitive* capital is defined as, "the resources providing shared representations, interpretations and systems of meaning among parties" [73]. It represents similar ambitions, visions, goals, and cultural values between organizational actors within a social system [73, 107]. Similar business goals is the degree to which parties share a common understanding and approach to the achievement of common tasks and outcomes [109]. It can guide the nature, direction, and magnitude of the efforts of the parties [54]. Committed parties have a deeper understanding of why the relationship exists and how they can contribute to the attainment of compatible goals [109]. Overall, cognitive capital

facilitates the development of common understandings and collective ideologies, outlining appropriate ways for supply chain partners to coordinate their exchanges, and share each other's thinking processes [92]. *Relational* capital entails the strength of the relationship, in which trust, friendship, respect and reciprocity are embedded and developed through firms' repeated transactions with their partners [62, 73, 107]. When trust is built through repeated transactions, decision makers tend to be less concerned about the opportunistic behavior of others [10, 109]. They are more willing to engage in open communication and show greater behavioral transparency [109]. Similarly reciprocity norms also serve to transform decision makers from self-centered partners into members of a relationship with shared interests and a sense of the common good [89, 109].

2.3 Relationship between social capital and organizational resilience

Firm requires both internal and external resources to overcome negative consequences of a disruptive event. A nurturing relationship with partner firms is one element of building resilience prior to, during and after the disruptive event [71, 87]. Social capital contributes to a firm's resilience capability [87] through acting as an information conduit, providing access to resources, increasing the efficiency of information diffusion, and minimizing redundancies [16]. Social capital, therefore, provides access to broader resources of high-quality, timely information and practical business advice [23] that can enhance a firm's capacity to handle unexpected disruptions [87]. Social networks and social capital are well established drivers of long-term post-disaster recovery [2, 69, 83]. In fact, previous studies suggest that quality of the social fabric is more important than other features (e.g., economic conditions) and external determinants (e.g., amount of damage) for successful post-disaster organizational recovery [20, 69]. However, social capital is not the only factor that is influential in building resilienc post-disaster. As suggested in previous studies other forms of capital such as human and financial can impart higher levels of resilience in the face of external change [8, 77].

2.3.1 Structural capital and organizational resilience

The flow of information and resources can be disrupted following a disaster. This creates uncertainty that may affect organizational survival [87]. One suggested mitigation strategy is the firm's access to information and resources of supply chain partners. Strong structural capital with external partners (e.g. suppliers and customers) is more likely to contribute to an organization obtaining valuable information and resources. Established networks in a post-disaster context can facilitate co-learning between organizations and provide access to additional resources, thereby enhancing response capacity [76]. Firms with strong and diversified structural capital have the flexibility to move to alternative networks not disrupted by the disaster, which contributes to improving reactive resilience capability [87]. Thus, firms with stronger structural capital in their supply chain will more likely respond and recover quickly post-disaster. Thus, we propose:

H1. Stronger structural capital improves a firm's reactive resilience.

Structural capital in the form of social interactions with supply chain partners usually develops over time, resulting in greater intensity, frequency, and breadth of information exchanged [58, 118]. Multiple connections and dense interactions at both individual and organizational level ensure that participants within social networks obtain and exchange more diversified resources and reliable information [17, 109]. Consequently, such organizations should be more aware of and detect potential disruptions quicker. For example, sharing information on orders, forecasts, upcoming disruptions, market trends and maintenance schedules with supply chain partners can help build organizational resilience [95]. Thus, firms that have stronger structural capital tend to share knowledge and resources that can help to refine and evaluate existing disaster plans [97]. Thus, we can propose:

H2. Stronger structural capital improves a firm's proactive resilience.

2.3.2 Relational capital and organizational resilience

Relational capital relates to the strength of ties between a firm and its supply chain partners based on trust, commitment, reciprocity, friendship, and respect [73, 107]. During an unexpected disruption, these partners are likely to offer resources that can facilitate firm recovery [87]. In particular, supply chain partners (i.e. customers and suppliers) are more likely to collaborate during unexpected events in terms of lead times, costs, and credit due to a trustworthy and mutually beneficial relationship. A firm's relational capital plays a critical role in responding to disruptions [1, 36] by facilitating the development of solutions for managing unanticipated changes and directing the common effort toward reaching mutually beneficial solutions [80]. Thus, we propose:

H3. Stronger relational capital improves a firm's reactive resilience.

While we argue that stable and trustworthy relationships enhance information sharing between a firm and its supply chain partners, Wang et al [110] assert that sharing information among network members minimizes the potential for future disruptions (i.e. building proactive resilience). Network members can anticipate changes in a proactive way (through appropriate monitoring system) and implement reliable solutions by building slacks in the supply chain. Thus, a cooperative relationship with supply chain partners is essential to share critical information [9, 112]. Information sharing increases the visibility of risks along the supply chain that can be mitigated, thereby enhancing the firm's resilience capability [31]. Thus, we propose:

H4. Stronger relational capital improves a firm's proactive resilience.

2.3.3 Cognitive capital and organizational resilience

Strong identification between a firm and its supply chain partners can stimulate a positive and constructive cognitive orientation that gives purpose during disruptive events [25].

Cognitive capital encourages supply chain partners to work toward preserving shared values and taking actions that will reduce uncertainty [32]. Extant literature on organizational resilience [e.g. 59, 71, 76] has emphasized the need for shared understandings in building resilience. Through mutual understanding and a common knowledge base, an organization can coordinate and exchange information more easily post-disaster. A pre-existing relationship facilitates high levels of co-operative and coordinated action necessary for business recovery [79]. In addition, cognitive capital can reduce the need for financial capital post disaster with supply chain partners who share the same values, vision, and purpose as the organization willingly taking appropriate steps to secure its survival [20, 87]. Thus, we propose:

H5. Stronger cognitive capital improves a firm's reactive resilience.

Cognitive capital can also encourage the convergence of interest among network members, which is useful for predicting potential risks and managing uncertainty. For example, shared learning (i.e. review of past disruptions jointly to learn from them) across firms is critical for anticipating future disruptions [95]. Leading firms in a network can provide training not only to their employees but also their supply chain partners (i.e. suppliers and customers) about security and supply network risks to raise awareness and reinforce the importance of resilience building activities [9, 96]. In inter-organizational settings, Nathan and Kovoor-Misra [74] highlight the importance of learning from other organization for crisis management. Firms that build cognitive capital through sharing knowledge and learning from each other, will be better equipped at minimizing disruptions. Thus, we propose:

H6. Stronger cognitive capital improves a firm's proactive resilience.

2.4 Proactive and reactive organizational resilience

Based on the information processing perspective, "the greater the task uncertainty, the greater the amount of information that must be processed during task execution to achieve a

given level of performance" [35]. This implies that managers will face less uncertainty and information processing needs when a task is well defined and executed [11]. Following a disruption, well defined tasks are critical for organizational response and recovery (i.e. reactive resilience practice). Organizations that have a clear understanding of the propensity for potential disruptions can recover faster [56, 101]. The pace of recovery will be dependent on sound business continuity plans [93]. McManus et al. [71] highlighted the role of disaster awareness in informing a firm's emergency response to disruption. Thus, proactive resilience allows a firm to react quickly and in the most effective way post-disaster. Hence, we propose:

H7. Stronger proactive resilience enhances reactive resilience.

Fig. 1. summarizes the main constructs of the study and the seven hypotheses developed.

[Insert Fig. 1 here]

3. Methodology

3.1 Study context

On May 12, 2008 at 2.28pm, a 8.0 (Mw.) destructive earthquake struck Wenchuan County in the Sichuan Province of China. This caused widespread damage across the province, resulting in 69,227 deaths, mainly for children under 5 years old, 374,643 injuries, and 17,923 missing persons [117]. Approximately 7,967,000 buildings were completely demolished, 24,543,000 were damaged, and the quake affected approximately 462 million people. The total disaster area was about 0.5 million square kilometers. The total direct economic losses that resulted from the 2008 Sichuan (Wenchuan) earthquakes were estimated at over 845.1 billion Chinese Yuan [117]. There was significant damage to physical infrastructure resulting in negative economic impacts [99]. There were extensive periods of business disruption, logistic difficulties, loss of customers and other operational issues that resulted in revenue decline [52]. The government provided various preferential policies for local enterprises and investors.

These policies included alleviating the tax burden on individuals, deducting partial administrative charges, supporting key enterprises and medium and small-sized enterprises, and adjusting industry entrance permission [75]. Given the lack of studies documenting the impact on businesses and examining the resilience of organizations post-quake as well as the role of social capital in business recovery, a sample of organizations that survived and were operational in 2018 (10 years after the earthquake) was surveyed.

3.2 Sampling and Data Collection

A list of 216 firms affected by the earthquake in Sichuan was initially identified using three different sources - Chinese Government report on post-quake recovery, yellow pages and Baidu search engine. From these sources, at least one email contact was identified. Following an initial email to all identified contact persons, a follow up phone-call was made if no response was received. Once the contact person agreed to complete the survey, the instrument was sent by email or dropped at the business premises. In total, 161 responses were collected from 88 firms. Among these 23 responses were deleted due to extensive missing information. We collected a single response from 50 firms, two responses from 26 firms and 3 responses from 12 firms. The final response rate was 40.7% and this is comparable to other similar studies that collected data from firms using a survey approach [see 60].

To test for non-response bias, we compared the responses of the early and late waves of completed surveys based on the assumption that the opinions of the late respondents were representative of the opinions of non-respondents [5]. Mann–Whitney U test yields no significant difference ($p > 0.05$) between early and late respondents based on a selection of indicators used in this study, suggesting that non-response bias is not a concern. To test for the robustness of our results based on single versus multiple responses from firms, we estimated the hypothesized paths for the model for the two groups using multiple group analysis and the results show no statistically different paths in the model on the basis of these two groups.

[Insert Table 1 here]

3.3 Survey instrument

All constructs were operationalized using multi-item reflective indicators on a 7-point Likert scale ranging from '1=strongly disagree' to '7=strongly agree'. Social capital was measured using 13 items adapted from previous studies [18, 107, 109] to assess firm's relationship with key supply chain partners (i.e. suppliers and customer) following the disaster. Structural capital was measured using four items from previous studies [107, 109] and measured the frequency of interactions and the multiple connections across diverse hierarchical levels and functions between firms and its supply chain partners. Cognitive capital was measured using four items adapted from existing studies [18, 107, 109]. These items mainly measure congruence in business philosophy, goals, interests and a shared vision between firms and their key supply chain partners. Relational capital was measured using five items adapted from previous studies [18, 109] that examined close interpersonal interaction, trust, friendship, respect, and reciprocity between firms and their supply chain partners.

Organizational resilience was measured using two dimensions – proactive and reactive. Proactive organisational resilience was measured using four items adapted from Bode and Macdonald [11] focusing on proactive activities before the earthquake such internal awareness, assessment of probability and impact of disruption, prevention capability, and contingency planning. Reactive organizational resilience was measured using five items adapted from Bode and Macdonald [11] and Pettit et al. [85]. These items mainly examined firm's reactive activities after the earthquake such as quickly identifying threatening situations, organizing a formal response team, and communication. The survey instrument was accompanied by an information sheet that specified the objective of the study and highlighted to respondents that we were interested in social capital and resilience issues post-quake.

A pilot study with a convenience sample of 20 managers from 10 firms was carried out before the main survey resulting in minor changes to the survey. The original questionnaire was designed in English and translated in Chinese language by one member of the research team. The translated version was verified by a professional transcriber who also back-translated the survey to ensure translational equivalence [14]. All respondents completed the Chinese version of the questionnaire.

To assess for common method bias (CMB), we adopted both procedural design and post-hoc analysis following Podsakoff, MacKenzie, Lee, and Podsakoff [86] and Liang, Saraf, Hu, and Xue [63]. For procedural design, first, we developed the survey in consultation with senior academics specializing in resilience, and pilot tested the survey as described above. Second, data were collected from respondents who possessed the relevant knowledge in the subject area. For example, the production/operations managers or purchasing managers who involved in supply chain functions and also aware of activities within an organization were selected using a screening question. Lastly, anonymity of the responses were maintained and the independent as well as the dependent variables in the survey was measured separately.

A post-hoc analysis of CMB was conducted in two ways. First, Harman's one-factor test was conducted on the 22 items informing the conceptual model [86]. The results showed that no single factor accounted for more than 34.98% of the observed variance. Second, we followed the common method factor approach for PLS to check for CMB (Liang et al.,[63]. "If the method factor loadings are insignificant and the indicators' substantive variances are substantially greater than their method variances", CMB is not an issue [63]. Table 2 shows that the average of variance square (R_a^2) are substantially greater than their method variances (R_b^2) with a ratio of 32.7:1 [46], thus further confirming CMB is not an issue in this study.

[Insert Table 2 here]

3.4 Data Analysis

PLS-SEM is non-parametric statistical method that offers several advantages, including the non-requirement of multivariate normality [40]. We examined skewness and kurtosis to determine data distributions [64], which revealed that the majority of variables in the dataset are non-normal, suggesting that PLS-SEM is appropriate for data analysis. PLS-SEM is also suitable for small sample sizes when the focus is on theory exploration rather than confirmation [40]. We analyzed the data using SmartPLS 3.2.8 [91]. We followed the sample size rule of "10 times the largest number of structural paths directed at a particular latent construct in the structural model" proposed by Hair, Ringle, and Sarstedt [40] for PLS SEM. According to this criterion we require a sample size of 70 to test our model and our current sample size (138) is larger. *Second*, we used power analysis software - G*Power (version 3.1.9.2) to determine minimum sample size for our model [39]. For a medium effect size of 0.25 and statistical significance level (i.e. alpha value) of 0.05 with a power value of 0.80 for three predictors, the minimum sample size requirement is 27. Thus, our sample size is larger than this requirement. Next, post-hoc analysis was conducted and the obtained power is 0.999 probabilities, suggesting the same results will likely reoccur in the same setting. This power analysis suggests the minimum sample size requirement is satisfied.

4. Findings

4.1 Sample characteristics

Majority of the surveyed organizations are from the manufacturing sector (66.7%) as shown in Table 3. Of respondents, the majority are males (78.9%), in the age bracket of 45 to 54 years old (46.4%), working in the firm as production/operations manager (34.1%), and being a university graduate (62.3%).

[Insert Table 3 here]

4.2 Outer model evaluation (measurement model)

The outer model was assessed by examining the reliability and validity of the measures [19], with item reliability threshold being 0.7 [40]. All items had significant factor loadings ($p<0.01$). Composite Reliabilities (CR) was used to assess the internal consistency of items representing the constructs. Table 4 shows that all CR were above the minimum required of 0.7 [78].

[Insert Table 4 here]

Fornell and Larcker's [34] criterion of average variance extracted (AVE) for each construct should be greater than 0.5 for establishing convergent validity. Table 4 shows that the AVE for all constructs ranged from 0.507 to 0.647, thus exceeding the stipulated threshold. Discriminant validity was established using two criteria presented in Table 5. First, according to Fornell and Larcker [34], the square root of AVE of each of the latent constructs should be higher than the construct's highest correlation with any other constructs and all correlations were less than the square root of AVE, thus establishing discriminant validity. Second, the Heterotrait-Monotrait (HTMT) ratio of correlations [44] was used to establish discriminant validity. The HTMT is an estimate for the factor correlation and is considered to be more robust than Fornell and Larcker's method [44]. In order to clearly discriminate between two factors, the HTMT ratio should be significantly smaller than the conservative level of 0.85 [43]. Table 5 shows that all the correlation ratios are below the critical level.

[Insert Table 5 here]

4.3 Inner model evaluation (structural model)

Following the outer model evaluation, the inner model was evaluated to assess the explanatory power and predictive relevance of the proposed model. Also, the size of the path

coefficients and the significance of the hypothesized relationships were estimated. In PLS, the main criterion for evaluating the structural model is the variance explained (R^2). The model explained 38.2% and 51.1% of the variance in proactive and reactive organizational resilience respectively.

[Insert Fig. 2 here]

Using the bias corrected bootstrapping method (5000 subsamples), the path coefficients were calculated. The results revealed that three out of the seven hypotheses (i.e. H_2, H_3, and H_7) were supported given that the p-value of less than 0.05 and t-value of more than 1.96. We also demonstrate the support for the hypotheses using Bias-Corrected and Accelerated (BCa) confidence intervals. If the confidence interval does not contain zero, then the path is considered supported or significant. Structural capital had no significant impact on reactive organizational resilience ($\beta = 0.026$, $t = 0.294$, $p = 0.769$) but has a positive influence on proactive organizational resilience ($\beta = 0.379$, $t = 3.161$, $p < 0.01$). As a result, findings do not support H_1 but support H_2. Relational capital has a direct and positive relationship with reactive organizational resilience ($\beta = 0.393$, $t = 4.268$, $p < 0.001$) but has no influence on proactive organizational resilience ($\beta = 0.035$, $t = 0.230$, $p = 0.818$). These findings support H_3 but do not support H_4. No significant relationships were found between cognitive capital and the two dimensions of reactive ($\beta = 0.106$, $t = 0.959$, $p = 0.338$) and proactive ($\beta = 0.202$, $t = 1.591$, $p = 0.112$) organizational resilience, rejecting H_5 and H_6. Proactive organizational resilience has a positive influence on reactive organizational resilience ($\beta = 0.271$, $t = 2.798$, $p < 0.01$).

Effect size (f^2) demonstrates the strength of a predictor (or independent variable) in explaining the dependent variable. Effect size f^2 value of 0.02, 0.15 and 0.35 can be viewed as a gauge for whether a predictor latent variable has a small, medium, or large effect at the structural level [45]. From Table 7, all the three supported hypotheses (i.e. H_2, H_3, and H_7) have small effects as f^2 values are in the range of > 0.02 to < 0.15. Small effect sizes but significant

relationships between endogenous and exogenous constructs are not uncommon in resilience studies [20, 88].

We used firm size (i.e. number of employees), the number of years a firm was in operation, and supply chain complexity as control variables in the proposed model. Firm size has no effect on proactive organizational resilience but has a positive impact on reactive organizational resilience ($\beta = 0.153$, $t = 2.511$, $p < 0.05$). Number of years a firm was in operation has no effect on proactive organizational resilience but has a negative influence on reactive organizational resilience ($\beta = -0.115$, $t = 2.008$, $p < 0.05$). Supply chain complexity has no effect on both reactive and proactive organizational resilience.

[Insert Table 6 here]

5. Discussion and Implications

This study evaluates the role of social capital as an external factor that builds organizational resilience (i.e. proactive and reactive organizational resilience). The findings confirm that structural capital can predict proactive organizational resilience and reactive organizational resilience can be predicted by relational capital. These findings have both theoretical and managerial implications.

5.1 Theoretical implications

Using SCT [3], we argued that networks and resources available to firms through their connections facilitate the development of organizational resilience. Similar to previous studies [28], we found that established relationships, both upstream and downstream, outside the organization build different facets of organizational resilience. Surprisingly, stronger structural capital does not improve reactive resilience contrary to H_1. A plausible explanation is that structural capital is not flexible enough to allow the firm to respond quickly to unexpected disruptions as suggested by Prasad et al. [87]. This could also be a systemic issue in

organizations where rapidity and ability to transform and change is impeded by existing norms, structures and processes [41]. Another is that the magnitude of the quake in Sichuan, which might have affected both the firm and its key supply chain partners, therefore providing limited pathways for this resource to be used as an adapative strategy for business recovery. However, stronger structural capital contributes to better proactive organizational resilience (H_2). Therefore, sharing information with key partners and interacting regularly with them post-disaster enable the organization to build resilience proactively, extending the result from previous studies [95] that do not consider the context of post-quake. This result suggests that structural capital facilitates the recognition of threats, allowing firms to quickly formulate and evaluate possible responses, and organize a formal response team in anticipation of a disruption. Accordingly, we can argue that business recovery through proactive organizational resilience is facilitated by structural capital. This aslo highlights the importance and role of pre-existing relationships with other organizations in facilitating organizational transformation and change post-disaster.

Mutual trust, commitment, reciprocity and respect are key attributes that exemplify strong relational capital in a network [73]. Often, organizations in such relationships collaborate to facilitate business recovery [87]. The result of H_3, suggests that stronger relational capital improves reactive organizational resilience. This implies that the key attributes described earlier allow an organization to quickly formulate responses to a disruptive event. This result also sheds light on the lack of support for H_1, with the conclusion that spending time and interacting often with key supply chain partners will not be effective unless these relationships transform into mutual trust, commitment, reciprocity and respect. Only then can an organization capitalize on the resources available from its supply chain partners to facilitate reactive organizational resilience. However, it must be recognized that positive behaviors such as trust, commitment and reciprocity emanate from organizational culture and

the norms and practices that are in place prior to the disruption. This result can also be explained by the influence of Confucian values on business relationships given that previous studies [105, 116], argue that mutual trust in interpersonal relationships matters more than business relationships in Chinese culture. Therefore, the cultural and organizational contexts to a large extent can also shape collaborative behaviors post-quake.

Contrary to H_4, stronger relational capital does not reinforce proactive resilience. This implies that personal interactions and high levels of reciprocity in the supply chain do not enable organizations to have higher awareness of disruptions, improve prevention capabilities and undertake contingency planning. This is possibly due to organizations focusing on recovery using other forms of capital (human and financial) in the short-term, and longer term recovery not being thought of as a function of the relationships developed with other firms. This contradicts the literature [9, 110, 112], which suggests that sharing of information should enable an organization to better plan for disruptions. Also, proactive organizational resilience depends on a firm's business continuity and disaster preparedness plans, and firms in this study may not have relied on supply chain partners in developing such plans.

Cognitive capital has no significant influence on both reactive (H_5) and proactive organizational resilience (H_6). This implies that having a shared vision, ambition, and pursuing collective goals neither allow the organization to recognize threatening situations nor create internal awareness of disruptions. In Confucian values, relationship prevails over task [116] but in business settings, relationships are based on an exchange of favors (*guanxi*). "*Guanxi* among organizations is initially established by, and continues to build upon personal relationships" [111]. Therefore, firms and their supply chain partners pursuing collective goals, for example, will be contingent upon having meaningful interpersonal relationships. If these relationships are not strong, they do not enable the organization to prepare for and respond to disasters. This implies that interpersonal relationships are important but must inform the

development of formal systems and procedures to cope with disruption. If organizational culture is built around transactional relationships, poorly designed structures and processes with supply chain partners, unexpected changes such as a disaster makes it more difficult for organizations to leverage these relationships to bounce back.

Stronger proactive organizational resilience informs better reactive resilience, as suggested by H_7. The result suggests that an organization that is aware and prepares for potential disruptions is more capable of reacting quickly by adapting resources. This relationship align with findings from previous studies [11] conducted in the context of other disasters. Therefore, having a recovery plan in place enables the organization to allocate scarce resources in such a way that business as usual happens faster [93]. As suggested by Pelling and Manuel-Navarrete [84], it is easier to transform a system inside out, implying that when internal processes and systems are resilient, it becomes easier to build resilience with systems outside of the organization.

5.2 Managerial implications

For an organization to develop proactive resilience based on its external networks and collaborations, the results of this study suggest that structural capital is an enabling factor. This implies that organizations have to invest in relationship building activities such as hosting events for key supply chain partners. The organization has also to set up communication protocols that encourages and facilitate employees to interact and share information with key supply chain partners. This may require breaking down silos within the organization [98] but may also require an organizational culture change, where value-systems, norms, processes, policies and procedures are geared for collaborative behaviors. The results also suggest that post-quake, organizations should capitalize on their interpersonal relationships with key supply chain partners, to develop ways to create awareness of and identify potential disruptive events. This requires strategic planning based around early warning systems that not only identifies

potential disruptions but are also capable for assessing the probability and impact of potential disruptions. These can be sector based so that firms within a sector have access to knowledge and can collectively develop resilience to unexpected events. To achieve this, slack resources within a system can be used to not only develop proactive resilience but also buffer the impact of unexpected disruptions [9]. Yet, these intitaives may also require examining existing governance structures and ways of cooperating to facilitate experimentation and learning [84].

While it seems that *guanxi* allows Chinese firms to develop strong relational capital on the basis of mutual respect, trust and reciprocity, these attributes improve only reactive resilience. These relationships must be used as the basis for developing resilience capability. The knowledge embedded in these relationships must be codified into norms, structures, systems, policies, processes and practices within and outside of the organization that allows for better disaster preparedness. As the results suggest, pre-disaster planning activities such as having contingency plans, situation monitoring, and disaster prevention capabilities enable organizations to adapt and adjust to the changed environment post-disaster.

6. Conclusion

In conclusion, the main contributions of this study are two-fold. First, we highlight the importance of social capital that emanates from external networks and collaborations as a factor helping to improve organizational resilience. Second, we demonstrate that not all forms of inter-firm social capital build proactive and reactive resilience, with structural capital influencing proactive resilience while relational capital influencing reactive resilience. Despite these contributions, the study is not without limitations. First, the sample characteristics limit generalizability of the results to other types of organizations and disruptions. The social capital of small firms and micro-enterprises has emerged as an important issue in the disaster management literature [20]. Future studies should consider how social capital facilitates or possibly hinders the recovery of such organizations post-disaster. Second, the sample is limited

to one cultural group and therefore the relationships identified are culture-specific. It would be worthwhile for future studies to evaluate the model proposed cross-culturally to better understand the dynamics between social capital and organizational resilience. Third, the firms surveyed in this study are those that have survived 10 years post-quake and potentially had some pre-existing levels of social capital prior to the quake. The results do not allow us to understand differences between those firms that did or did not use social capital, which would be an area of further research. Fourth, it is possible that firms in this study were resilient before the quake and this study does not capture pre-existing levels of resilience. Instead, we measure proactive aspects of resilience which include preparedness for disruptions.

7. References

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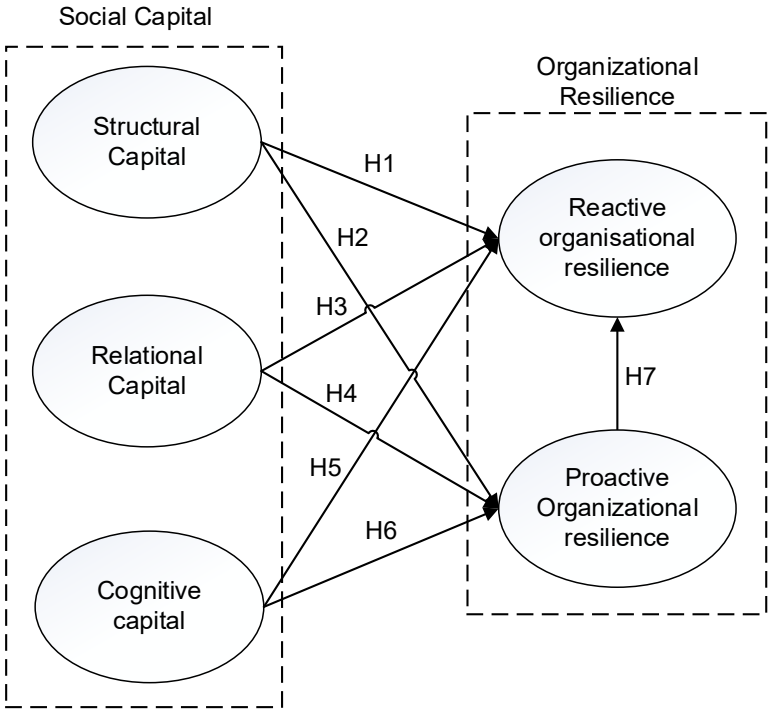
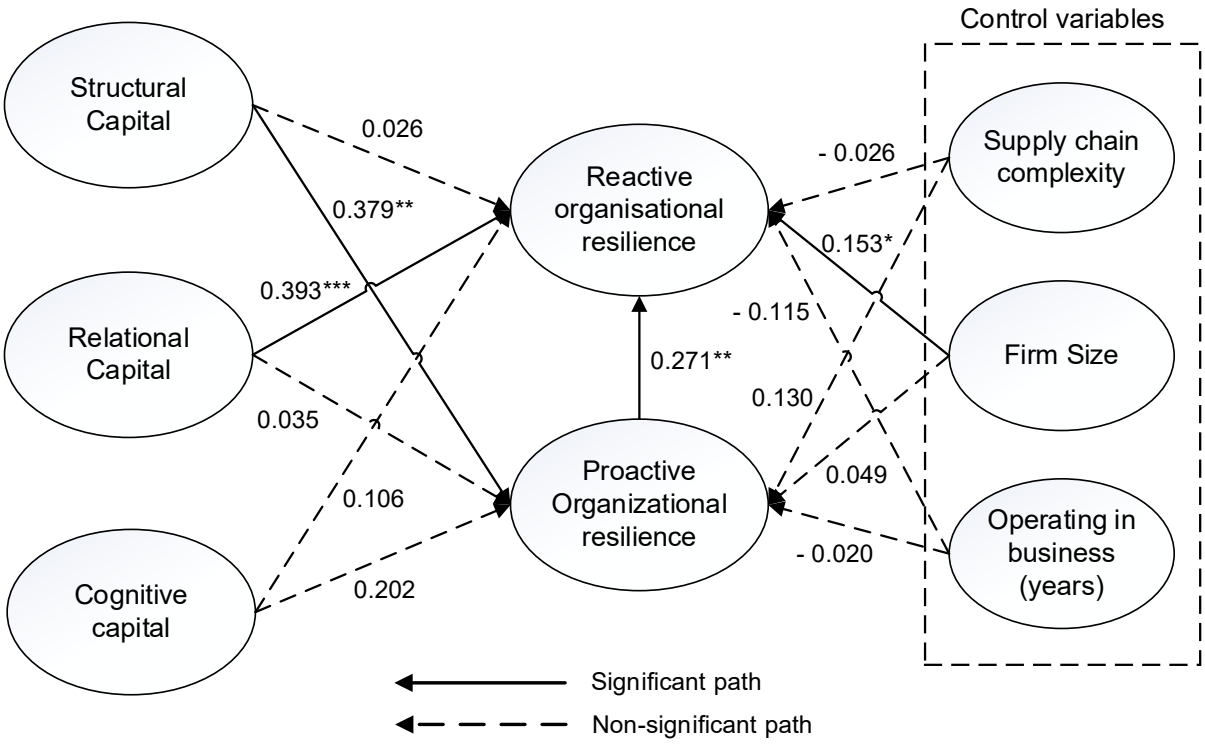


Fig. 1. Conceptual framework and hypotheses



*****p < 0.001, **p < 0.01, *p < 0.05**

Fig. 2. Full structural model

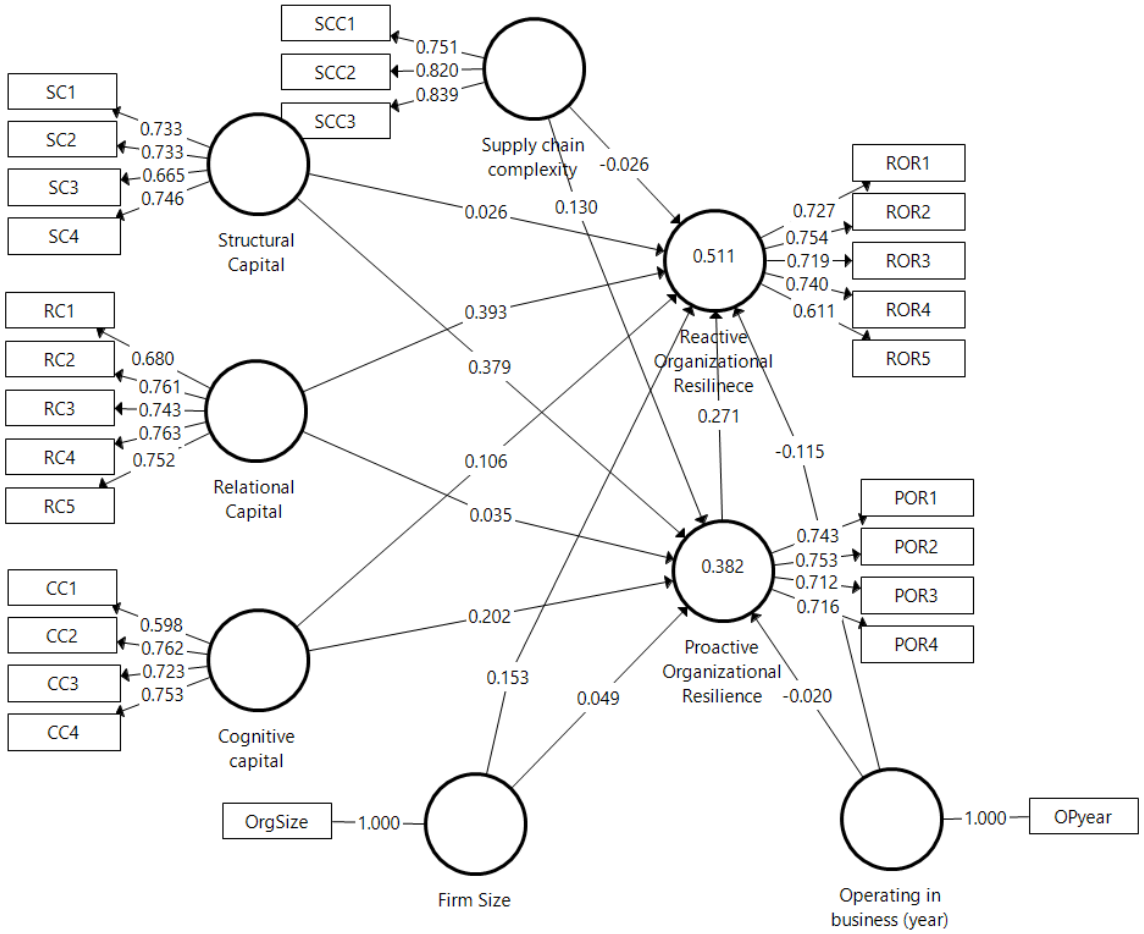


Fig. 3. Full Structural Model (using SmartPLS 3.2.8)

Table 1

Mann–Whitney U test result

Variables	Z-value	Significance (2-tailed)
SC1	-1.335	0.182
SC4	-1.249	0.212
CC1	-0.479	0.632
CC2	-0.620	0.535
RC4	-1.718	0.086
RC5	-0.745	0.456
POR3	-0.905	0.365
POR4	-1.119	0.263
ROR2	-0.477	0.633
ROR5	-0.018	0.986

Table 2

Common Method Factor Analysis for CMB.

Latent constructs	Indicators	Substantive factor loading (R_a)	Substantial variance square (R_a^2)	Method factor loading (R_b)	Method variance square (R_b^2)
SC	SC1	0.733***	0.537	-0.151 ^{NS}	0.023
	SC2	0.733***	0.537	0.060 ^{NS}	0.004
	SC3	0.665***	0.442	-0.003 ^{NS}	0.000
	SC4	0.746***	0.557	0.088 ^{NS}	0.008
RC	RC1	0.680***	0.462	0.056 ^{NS}	0.003
	RC2	0.761***	0.579	-0.153 ^{NS}	0.023
	RC3	0.743***	0.552	-0.190 ^{NS}	0.036
	RC4	0.763***	0.582	0.011^{NS}	0.000
	RC5	0.752***	0.566	0.271*	0.073
CC	CC1	0.598***	0.358	-0.250*	0.063
	CC2	0.762***	0.581	0.021 ^{NS}	0.000
	CC3	0.723***	0.523	0.127 ^{NS}	0.016
	CC4	0.753***	0.567	0.062 ^{NS}	0.004
POR	POR1	0.743***	0.552	-0.131 ^{NS}	0.017
	POR2	0.753***	0.567	-0.127 ^{NS}	0.016
	POR3	0.712***	0.507	0.036 ^{NS}	0.001
	POR4	0.716***	0.513	0.240*	0.058
ROR	ROR1	0.727***	0.529	0.062 ^{NS}	0.004
	ROR2	0.754***	0.569	-0.033 ^{NS}	0.001
	ROR3	0.719***	0.517	-0.027 ^{NS}	0.001
	ROR4	0.740***	0.548	0.024 ^{NS}	0.001
	ROR5	0.611***	0.373	-0.032 ^{NS}	0.001

a. SC = Structural capital; RC = Relational capital; CC = Cognitive capital; POR = Proactive organizational resilience; ROR = Reactive organizational resilience.

b. ***$p < 0.001$; ** $p < 0.01$; * $p < 0.05$, NS = insignificant

Table 3

Profile of respondents

Industry Sector	**Frequency**	**Percentage**
Manufacturing	92	66.7%
Social service	15	10.9%
Retail	8	5.8%
Construction	8	5.8%
Hospitality	6	4.3%
Logistics	3	2.2%
Media	2	1.4%
Energy	2	1.4%
Telecommunication	2	1.4%
TOTAL	**138**	**100%**
Occupation		
Production/Operations manager	47	34.1%
Purchasing manager	33	23.9%
Supply chain manager	23	16.7%
CEO/General manager	16	11.6%
Risk manager	6	4.3%
Managing director	4	2.9%
Others	9	6.5%
TOTAL	**138**	**100%**
Organizational size (numbers of employee)		
250 to 499	49	35.5%
500 to 999	46	33.3%
1,000 or more	43	31.2%
TOTAL	**138**	**100%**
Level of education		
High school or less	2	1.4%
College graduate	18	13.0%
University graduate	86	62.3%
University post graduate	26	18.8%
Doctoral degree	5	3.6%
Others	1	0.7%
TOTAL	**138**	**100%**
Gender		
Male	109	78.9%
Female	29	21.1%
TOTAL	**138**	**100%**

Industry Sector	Frequency	Percentage
Age		
26 to 34	9	6.5%
35 to 44	55	39.9%
45 to 54	64	46.4%
55 to 64	10	7.2%
65 and above	0	0
TOTAL	**138**	**100%**

Table 4

Scale validity and reliability

Scales	Std. Loading	*t-value*
Structural Capital (CR = 0.811, AVE = 0.518)		
SC1: We spend time together in social occasions with our key supply chain partners.	0.733	16.654
SC2: We maintain a close social relationship with our key supply chain partners.	0.733	11.777
SC3: We promote an interaction between the personnel across difference levels of our company and our key supply chain partners.	0.665	9.404
SC4: We promote an interaction across different functions (logistics and marketing) within our company and between our key supply chain partners.	0.746	13.970
Relational capital (CR = 0.858, AVE = 0.548)		
RC1: Our relationship with our key supply chain partners is characterised by close personal interactions at multiple levels.	0.680	10.732
RC2: Our relationship with our key supply chain partners is characterised by mutual respect at multiple levels.	0.761	14.768
RC3: Our relationship with our key supply chain partners is characterised by mutual trust between the parties.	0.743	12.986
RC4: Our relationship with our key supply chain partners is characterised by personal friendship at multiple levels.	0.763	17.096
RC5: Our relationship with our key supply chain partners is characterised by high levels of reciprocity.	0.752	15.766
Cognitive capital (CR = 0.803, AVE = 0.507)		
CC1: Our organization shares the same ambitions and vision with our key supply chain partners.	0.598	7.130
CC2: People in our organization and those of our key supply chain partners are enthusiastic about pursuing the collective goal of the whole supply chain.	0.762	17.370
CC3: Both this organization and our key supply chain partners agree on what is in the best interest of the relationship.	0.723	12.507

Scales	Std. Loading	*t-value*
CC4: Executives from this organization and our key supply chain partners have compatible philosophies/approaches to business dealings.	0.753	13.549
Proactive organizational resilience (CR = 0.821, AVE = 0.535, Q^2 = 0.170)		
POR1: We created internal awareness for disruptions and made attempts to drive this awareness to our employees	0.743	13.390
POR2: We analysed and assessed both probability and impact of potential disruptions	0.753	14.831
POR3: We improved our disruption prevention capabilities.	0.712	13.702
POR4: We engaged in contingency planning to prepare for potential disruptions	0.716	13.510
Reactive organizational resilience (CR = 0.836, , AVE = 0.507, Q^2 = 0.226)		
ROR1: We are able to quickly recognize that there is a threatening situation	0.727	16.655
ROR2: We are able to gather and interpret information of cues to gauge the magnitude, location, and causes of the disruption.	0.754	17.366
ROR3: We are able to quickly identify, formulate, and evaluate a set of possible responses to disruption.	0.719	13.465
ROR4: We can quickly organize a formal response team of key personnel, both on-site and at corporate level.	0.740	17.856
ROR5: We are very successful at dealing with crises, including addressing public relations issues.	0.611	7.138
Supply chain complexity (CR = 0.846, and AVE = 0.647)		
SCC1: Our supply chain is very complex	0.751	6.031
SCC2: Our supply chain involves lots of players (e.g. suppliers, logistics service providers) and/or a lot of logistics/transportation transactions	0.820	11.211
SCC3: Our supply chain was a quite intricate network	0.839	13.211

Table 5

Descriptive statistics

Scales	Minimum	Maximum	Mean	Std. Dev
Control variables				
Supply chain complexity	2.67	7.00	4.819	0.975
Firm size	5.00	7.00	5.960	0.818
Operating years of business	11.00	66.00	28.220	12.423
Structural capital	3.00	7.00	5.415	0.819
Relational capital	2.20	7.00	5.615	0.828
Cognitive capital	2.25	7.00	5.600	0.766
Proactive organizational resilience	2.25	6.75	5.326	0.746
Reactive organizational resilience	2.80	6.80	5.383	0.738

Table 6

Fornell and Larcker criterion and HTMT ratio for discriminant validity

Latent Constructs	1	2	3	4	5	6
Cognitive capital (1)	**0.712**	0.697	0.741	0.781	0.708	0.366
Proactive organizational resilience (2)	0.499	**0.731**	0.741	0.616	0.801	0.436
Reactive organizational resilience (3)	0.543	0.548	**0.712**	0.810	0.742	0.312
Relational capital (4)	0.701	0.475	0.633	**0.741**	0.873	0.394
Structural capital (5)	0.623	0.575	0.543	0.654	**0.720**	0.395
Supply chain complexity (6)	0.269	0.309	0.237	0.309	0.287	**0.804**

Note: square root of AVE is shown in bold in the diagonal; Lower half of diagonal is Fornell and Larcker criterion and upper half of the diagonal is HTMT ratio.

Table 7

Path coefficients and size effects

Paths	Std. Path coeff. (β)	t- stats	p-values	BCa Confidence intervals 2.5%	BCa Confidence intervals 97.5%	f^2	Hypothesis
Structural capital → Reactive organizational resilience	0.026	0.294	0.769	-0.141	0.199	0.001	H_1 not supported
Structural capital → Proactive organizational resilience	0.379	3.161	0.002	0.156	0.623	0.109	H_2 supported
Relational capital → Reactive organizational resilience	0.393	4.268	0.000	0.207	0.565	0.123	H_3 supported
Relational capital → Proactive organizational resilience	0.035	0.230	0.818	-0.264	0.322	0.001	H_4 not supported
Cognitive capital → Reactive organizational resilience	0.106	0.959	0.338	-0.105	0.324	0.009	H_5 not supported
Cognitive capital → Proactive organizational resilience	0.202	1.591	0.112	-0.041	0.452	0.027	H_6 not supported
Proactive organizational resilience → Reactive organizational resilience	0.271	2.798	0.005	0.085	0.464	0.093	H_7 supported