

# THE RESILIENCE OF AGRO-FOOD SUPPLY CHAIN DURING THE COVID-19 ERA

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## **Abstract**

An unprecedented crisis has forced to impose lockdowns and to declare states of alarm in Spain. These restrictions have had an important impact on the normal activity of firms. This study aims at assessing the impact of COVID-19 crisis on the agro-food sector and determining the factors that could contribute to build the resilience of firms in the supply chain context. To do so, we use a structural equation modelling based on social capital theory. We found evidence that the agro-food supply chain in Catalonia has shown a degree of resilience amid the pandemic to meet the basic requirements to feed a confined population. Our results also show that social capital plays an important role in building both active and proactive organizational resilience which is a key factor toward a sustainable agro-food sector.

**Keywords:** Supply Chain, COVID-19, Disruption, Social Capital, Resilience

**JEL code:** C1, D81, Q11

## **1. Introduction**

Nowadays, actors involved in agro-food supply chain are facing disruptive events that could threaten their operations and performance (Williams et al., 2017). Assessment both the nature and impact of global crisis on organizations has drawn broad research interest. Such analysis is important as it examines how firms may effectively prepare for, respond to, and overcome disruptive issues (Sutcliffe and Vogus; 2003 Jia et al., 2020;). Previous research has attempted to study the resilience of firms to respond to disruptive actions and to adapt their mitigation strategies to new business environment (Van Der Vegt et al., 2015; Williams and Shepherd, 2016).

The literature on organizational resilience provides key definitions to understand the resilience concept as well as attempts to identify major factors, both internal and external (Jia et al, 2020), that help firms to be more resilient than others (Williams et al.,2017; Duchek, 2020). Consistently, Seville et al., (2015) suggested that leadership, supply chain management, employee engagement and disaster planning, among others, could build the organizational resilience. These factors are mainly associated to the institutional, cultural and organizational norms, governance systems with which firms are operating (Folke et al., 2005; Pelling and Manuel-Navarrete, 2011). Several scholars have applied interchangeable definitions related to organizational resilience.

Most of existing studies rely on the disaster life cycle as the theoretical paradigm to conceptualize resilience (Jia et al., 2020). The consensus in the literature converges toward the capacity of firms to respond and recover from unforeseen disruptions including organizational readiness aspects (Bhamra et al., 2011; Sutcliffe and Vogus, 2003). Accordingly, Ates and Bititci (2011) and Koronis and Ponis (2018) put together the interconnection between readiness or preventive abilities of firms and their reactive aptitudes for business recovery aims. In this regard, knowledge about both proactive and reactive capabilities of firms would be of great importance to build organizational resilience as well as for policy makers who are interested in enhancing the performance and competitiveness of agro-food supply chain. In this vein, Jia et al. (2020) defined 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”.

Within the organizational resilience literature, a first group of studies (Coutu, 2002; Hafeez et al., 2002; Horne and Orr, 1998) has focused on the characteristics of resilience based on several attributes (e.g., strong governance, involved staff and capacity to take quick

decisions). On the other hand, a second group (Pal et al., 2014; Ortiz-de-Mandojana and Bansal, 2016; Martinelli et al., 2018; Parker and Ameen, 2018; Tisch and Galbreath, 2018; Chowdhury et al., 2019) has been mainly interested in measuring (Lee et al., 2013; McManus et al., 2008) and identifying the determinants of organizational resilience (Pal et al., 2014; Tisch and Galbreath, 2018; Chowdhury et al., 2019;).

Borekci et al. (2014) advocate that the relevance of internal and external factors depends on organizational culture, values and systems. Cooperation (Reinmoeller and Van Baardwijk, 2005), relational behavior (Borekci et al., 2015), and partnership (Macuzic et al., 2016) are found to be external factors that may contribute to resilience of firms. In addition, past studies have suggested that social capital plays a key role in mitigating disaster risk and helps firms to return to their normal activities (Monteil et al., 2020). Consistently, Aldrich (2011) claims that social capital represents, “the strongest and most robust predictor of recovery after a catastrophe”. In this aspect, Jia et al. (2020) clearly state that social capital stemming from supply chain partners is an important external factor that builds both proactive and reactive resilience of firms. The author argued that networks and resources available to firms thanks to their relationship with other actors contribute to more resilient business environment (Aldrich, 2012; Seville et al., 2015).

The year 2020 could be considered in history as the year of Covid-19 pandemic. An unprecedented crisis that has forced the European countries to impose lockdowns and to declare states of alarm. These restrictions have had a significant impact on the normal activity of firms. The agro-food sector has not been an exception, despite having been declared as an essential economic activity. In addition to the catering sector, the impact of Covid-19 has affected all the supply chain actors, to a greater or lesser extent, having to adapt quickly to the different restrictions adopted by the authorities to give up the spread of the pandemic.

The covid-19 crisis presents significant health problems for the population. In addition to the human impact, it is also having a clear impact on supply chains from food production to food marketing. The COVID-19 pandemic has become a major risk for the normal operation of firms. On the other hand, information regarding the behavior of producers and different actors involved in the agro-food supply chain and their needs are very scarce in Spain. In this context, the present study responds to the increasing social concerns about the impacts of COVID-19 and to what extent the agro-food supply chain meets the needs of society. Second, our work attempts to examine the resilience of agro-food supply chain as well as to determine the factors that may contribute to build the adaptive resilience of firms. To our knowledge, an issue that has not been investigated in the agro-food sector so far. Thus, ours will provide a

more comprehensive view of proactive and reactive aspects of organizational resilience in the context of COVID-19. The findings would have implications for different stakeholders involved in the agro-food supply chain.

The remainder of this paper is organized as follows. The next section presents the theoretical and methodological framework to carry out this analysis. Then, the empirical findings are discussed. Finally, we finish the paper with concluding remarks and some policy implications.

## **2. Theoretical Framework**

The resilience concept is firstly introduced by the ecologist scientists and refers to the ability of a structure to absorb change, whereas holding development conditional on perturbations and varying circumstances (Holling, 1973). In social science, from a management and organizational perspective the notion of resilience is widely related to the organization's survival to withstand unexpected changes (Hall et al., 2018). Furthermore, other research studies assert that resilience must encompass recovery time, ability, and costs aspects (Hamel and Valikangas, 2003; Annarelli and Nonino 2016). Therefore, Ortiz-de-Mandojana and Bansal (2016) defined organizational resilience as “the incremental capacity of an organization to anticipate and adjust to the environment”.

Jia et al. (2020) provided an extensive review of alternative definitions of organizational resilience and found a common consensus that converges toward the focus simultaneously on “reactive” (passive) and “proactive” (active) aspects” of resilience for business sustainability (Sutcliffe and Vogus, 2003; Ates and Bititci, 2011). While the former aspect refers to the firm's response to and its capacity to “bounce back” from disruptive events (Sutcliffe and Vogus, 2003), the latter aspect emphasizes on the firm's ability to foresee and actively wait (Sull, 2005) for creating an organization's readiness for change (Giustiniano et al., 2018). Bode and Macdonald (2017) describe the supply 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”.

Following past studies, proactive resilience consists of four key components namely, awareness of potential interruptions, potential impact self-assessment, self-improvement for prevention abilities, and commitment to plan and prepare for crisis management (McManus et al., 2008; Linnenluecke et al., 2012; Lee et al., 2013; Bode and Macdonald, 2017). The latter authors state that gathering and interpreting necessary information could lead to reduce the negative impact of unexpected crisis, without overlooking the role of firm size, existing

relationships and structures to build the adaptive know-hows of firms (Carey et al., 2011). Such practice could help firms to improve their rapid responsiveness to a disruptive event. Consistent with previous research, reactive resilience may integrate five strategic activities associated with disruptions: rapid recognition; quick collecting and diagnosis of information; fast generating of reactions (Bode and Macdonald, 2017); capacity to rapidly establish a formal response group and achievement in dealing with the crisis (Pettit et al., 2013).

Social capital is another key factor that might contribute to build resilience of firms (Aldrich, 2012; Sanyal and Routray, 2016; Hsueh, 2019; Monteil et al., 2020). Doerfel et al. (2010) claim that firms can count with their existing relationships and social networks (Carey et al., 2011) among supply chain partners (suppliers or customers), through exchange and providing access to resources, to overcome unexpected disruptions and to rapidly retrieve their normal activities. Structural, relational, and cognitive capital are used as proxies of social capital (Nahapiet and Ghoshal, 1998). Given the specificity of the agro-food sector supply chain, this study only focuses on the first two dimensions to measure the role of the social capital in building firm's resilience.

Structural capital draws the configuration of different contact points within and across different organizations (Nahapiet and Ghoshal, 1998), which allows to exchange and to get access to reliable, diverse and timely information as part of a warning system (Koka and Prescott, 2002; Capaldo, 2007; Villena et al., 2011). Whereas, relational capital reflects the relationship strength between firms based on friendship, mutual benefits and collaboration created through repeated transactions (Nahapiet and Ghoshal, 1998; Tsai and Ghoshal, 1998; Li et al., 2016).

Firm may need both internal and external resources to cope with negative impacts of disruptive events prior to, during and after the crisis (McManus et al., 2008; Prasad et al., 2015; Jial et al. 2020). Prasad et al. (2015) argued that social capital and networks can improve a firm's ability to overcome unexpected disruptions. As suggested by previous studies, social capital is not the only driver to build organizational resilience, but also marketing channels diversification and firm size may affect organizational survival. Figure 1 illustrates the theoretical framework and hypotheses to carry out the empirical analysis.

Therefore, we propose the following hypothesis to examine the impact of the aforementioned factors on the resilience of firms in the agro-food supply chain context:

**H1.** Strong structural capital with external partners (e.g. suppliers and customers) more likely to contribute to enhance the reactive resilience ability of firms (Nilakant et al., 2014; Prasad et al., 2015; Jia et al., 2020).

**H2.** Firm with strong structural capital tends to share information and resources that improve its proactive resilience ability (Capaldo, 2007; Villena et al., 2011; Scholten and Schilder, 2015; Scholten et al., 2019; Jia et al., 2020).

**H3.** Stronger relational capital with supply chain partners based on engagement, mutually beneficial relationship would improve organizational reactive resilience (Nahapiet and Ghoshal, 1998; Tsai and Ghoshal, 1998; Gittell et al., 2006; Prasad et al., 2015; Ahangama et al., 2019; Jia et al., 2020).

**H4.** Strong relational capital through sharing information would reduce the potential for future disruptions and risks along the supply chain that can lead to build firm's resilience capability (Blackhurst et al., 2011; Aldrich, 2012; Wieland and Wallenburg, 2013; Wang et al., 2018; Jia et al., 2020).

**H5.** Strong proactive resilience through well-defined tasks and established plans is likely to improve the organizational response and recovery (i.e. reactive resilience practice) (McManus et al., 2008; Bode and Macdonald, 2017; Koronis and Ponis, 2018; Sahebjamnia et al., 2018; Jia et al., 2020).

**H6-H7.** Firm size can affect both reactive and proactive resilience of firms (Bode and Macdonald, 2017).

**H8-H9.** Diversifying marketing channels could have positive relationship with reactive and proactive resilience.

### **3. Methodological framework**

The empirical model consists of 16 observed variables integrating four latent variables. In addition, firm size (i.e. number of workers) and the degree of diversification in marketing channels are also used as control variables to estimate the model. Two "resilience latent variables" (proactive and reactive resilience) and two "social capital latent factors" (structural and relational capital) were identified (table 3). We defined all constructs based on indicators and evaluated on a Likert scale ranging from '0=strongly disagree' to '10=strongly agree'. Seven items are adapted from previous studies (Tsai and Ghoshal, 1998; Carey et al., 2011; Villena et al., 2011, Jia et al., 2020) to define social capital indicator to assess firm's relationship with main supply chain actors. Thus, we measured structural capital using four components reflecting the interactions frequency and multiple connections across different hierarchical levels and activities between firms and its supply chain partners.

In addition, the relational capital variable embraces three items that refers to collaboration with competitors and support from associations and mutual beneficial

relationship between firms and partners (Carey et al., 2011; Villena et al., 2011). As mentioned previously, organizational resilience is decomposed into proactive and reactive dimensions. Following Bode and Macdonald (2017), proactive resilience is defined using four items that focuses on practices before the lockdown such as internal awareness, assessment of likelihood and impact of interruption, prevention ability, and contingency strategy. Whereas, five items were used to measure reactive resilience (Pettit et al., 2013; Bode and Macdonald, 2017), examining firm's reactive aspects after the lockdown like rapid identification of threatening situations, establishing a formal response group, and communication. The survey also includes additional information on financial and socioeconomic characteristics of firms.

To examine the relationships between latent variables based on observed indicators and to validate the hypotheses specified in the theoretical model (Figure 1) we use the structural equation modelling (SEM) approach (Hair et al., 2014; Kline, 2016). The latter is adopted to estimate the path parameters' effect and sign assumed amongst variables. The evaluation of the SEM performance mainly relies on path significance, the direction of parameters according to the theory and different fit criteria following recommended values proposed in previous literature (Hair et al., 2014). Table 1 provides summary statistics of all variables used in our empirical model.

### **3.1. Study context and data collection**

Given a few empirical studies investigating the impact of COVID-19 on agro-food supply chain in general and examining the resilience of firms during the pandemic in particular, we interviewed a sample of agro-food firms that survived and were still operating in 2020-2021. A list of firms was initially identified using email contacts of managers who are involved in the supply chain operations (e.g., production, purchasing, processing and distribution). The list of contact was provided by the Department of Climate Action, Food and Rural Agenda in Cataluña. The survey has been distributed to all identified actors and was conducted between August and November 2020. Then, we followed up the survey through three reminders if no response was received. The final sample of this study consists of 98 firms. Most of the surveyed firms belong to the primary sector representing (53%) of total interviewed firms, followed by the processing industry (37%) and both wholesalers and retailers (5% for each case). About 70% of the respondents are males, with an age between 50–64 years old (67%) and generating an annual income between 0.5 and 5 M€.

## **4. Empirical Results**

Results reveal that the impact of the pandemic differs depending on the products and services, as well as the type of actors along the supply chain. On a scale of 0 to 10, the impact has been

uneven, affecting more the retail sector and the processing industry and less the primary sector. The agro-food sector is classified as essential for the emergency state. Despite the state of alarm, different actors along the Catalan supply chain have demonstrated a social responsibility to continue feeding the population and providing necessary inputs and services for the chain. Thus, 88% of the actors kept partially operating under contingency plans and avoided interrupting their supply chain. Moreover, the interruption of catering sector, retaining a major part of the production at local market, has induced some difficulties that could be only overcome as long as the situation was normalized and the restauration and tourism channels were reactivated. Accordingly, a general decrease in marketing channels can be observed due to the restrictions applied to alleviate the pandemic spread, especially that go to the restaurant and tourism sector (hotels, restaurants and catering) (-47%) where the reduction in demand stands out and direct sales to consumers in establishments (-12%) followed by sales in traditional stores (-7%). On the other hand, actors affected by the pandemic have implemented other measures to offset the effects of the crisis (Briz et al., 2020), highlighting the opening of direct sales channels to retailers through web platforms and consumers through online sales and home deliveries.

Moreover, the adoption of confinement measures due to the spread of COVID-19 led to an unprecedented decline in business figures during the lockdown period from March to June 2020. Demand for products and revenues were reduced by 5% and 13% compared to the same period of previous year in the primary sector, respectively. At the same time, the industry and the wholesale trade registered a more moderate decrease of 10% in turnover volume and -7% and -2% in demand compared to March 2019, respectively. In this context, all the analyzed sectors have experienced a revenue loss except the retail sector (Cluster de Alimentacion de Euskadi, 2020). This health crisis has brought additional costs due to movement restrictions applied to both goods and people, transport limitations, significant reduction in consumption, increase in prices of raw materials and necessary investments in health protection measures. This is mainly due to very restrictive quarantine measures of economic activity adopted by the Generalitat and the Spanish governments. A quarter of those surveyed have experienced some level of supply disruption during the state of alarm. On the other hand, the stock break of some products has affected the volume of sales among supply chain tiers, representing 14% of the annual turnover, on average.

To alleviate the economic impact caused by the COVID-19 epidemic, the government has approved urgent economic measures to minimize the impact of this crisis and to support firms through preferential policies (alleviate tax burden, postponing loan repayments,



supporting key enterprises, etc.). About 70% firms operating in the wholesale sector have requested financial support during the state of alarm to reduce the consequences of health crisis. In addition, 23% of the total respondents have applied for a loan from the private sector during the lockdown period. These efforts are very important for firms, especially small and medium sized enterprises, to avoid revenue losses and to speed the recovery of economic activity in the short and medium term.

Despite the negative impact on the sector, this does not translate into a sharp reduction in the number of workers. The rapid adoption of adaptability strategies would have favored this situation. On the other hand, measures to prevent the spread of the virus have led to a labor shortage for some firms. Only 12% of the respondents have suffered problems to find workforce.

Table 3 confirms that all factor loading estimates are statistically significant and the composite reliability (CR) statistic for all constructs meets the minimum required of 0.7 (Nunnally and Bernstein, 1994), indicating good internal consistency reliability among items, except for two factors. Nevertheless, the latter are above 0.60 and considered in our model.

Table 4 reports the SEM results and the goodness-of-fit statistics. Overall, the empirical model meets the accepted goodness-of-fit criteria (Fornell and Larcker, 1981; Hair et al., 2014; Kline, 2016) pointing out that the conceptual model adequately fits our data. Furthermore, we determine the path coefficients' magnitudes and the significance of hypotheses with respect to different relationships. Results show that the analyzed variables are statistically significant in explaining organizational resilience and the model accounts for 24% and 55% of the variance in proactive and reactive organizational resilience, respectively.

Figure 2 shows the estimated conceptual framework composing of organizational resilience, social capital, marketing channel diversity and firm size. Empirical results reveal that five hypotheses (i.e. H1, H2, H5, H7 and H9) are significantly supported. We found that structural capital displays a direct and positive association with both reactive and proactive resilience of firms. In contrast, the conceptual model does not support the relationship between relational capital and the two dimensions of firm's resilience, rejecting H3 and H4. Firm size is further positively related to proactive resilience. Diversification of marketing channels tend to have a positive influence on proactive organizational resilience. Finally, our findings support that proactive organizational practices positively affect the reactive resilience of firms.

## **5. Discussion and implications**

This study examines the role of social capital that can play as an external factor to build the firm's resilience within the agro-food supply chain. Our empirical findings support that

structural capital contributes to improve both proactive and reactive resilience while relational capital has no significant impact on organizational resilience. Thus, these findings might provide important implications for firm management decisions to deal with current and future disruptive events.

Consistent with previous studies (Doerfel et al., 2010), we found evidence that established relationships between actors helps enhance the resilience along the supply chain. As expected, stronger structural capital would improve both reactive and proactive resilience of firms. One possible explanation is that flexible structural capital is likely to let firms respond rapidly to unpredicted disruptions. Both the local and national governments have provided privileged policy decisions to help firms, especially small and medium sized enterprises, to change and adapt some norms and processes (Hall et al., 2018) to overcome operational issues and to facilitate business recovery.

Sharing information with key supply chain actors and cooperating regularly contribute to better proactive resilience of firms (Blackhurst et al., 2011; Wieland and Wallenburg, 2013; Scholten and Schilder, 2015; Wang et al., 2018; Jial el al., 2020). This finding asserts that stronger structural capital allows to recognize threats, to quickly diagnose and elaborate possible responses that anticipate potential impact of a disruption and avoid deep business loss (Jia et al., 2020). Surprisingly, results suggest no significant effects of existing relationships between actors on organizational resilience. Nevertheless, the relational capital based on mutual collaboration and benefit and engagement in association show a positive impact on proactive resilience to assist in better business recovery (Prasad et al., 2015). Contrary to Jia el al.'s (2020) finding, ours do not found direct link between personal interactions and resilience of firms. This could be attributed to the importance of other forms of capital (human and financial) in the short-term to improve prevention capacity of firms and to undertake contingency scenarios (Jia et al., 2020). Accordingly, the interactions between actors along the supply chain would be effective as long as these relationships must be translated into higher mutual commitment and reciprocity prior to disruptive events.

Our results support previous findings (Pelling and Manuel-Navarrete, 2011; Bode and Macdonald, 2017; Sahebjamnia et al., 2018; Jial et al., 2020), reporting that stronger proactive resilience of firm may strengthen the reactive resilience (H5). This finding suggests that awareness of and preparing for potential interruptions is likely to enhance its reaction ability to quickly bounce back. However, this may require a collaborative behavior of firms where cultural and organizational aspects are well internally and externally embedded within and

between firms along the supply chain (Nahapiet and Ghoshal, 1998; Tsai and Ghoshal, 1998; Jia et al., 2020).

## **6. Conclusion**

The Covid19 pandemic has generated economic, social and consumer habits changes that have directly affected the agro-food supply chain. The present study examines the role that social capital originating from supply chain networks and collaborations plays in improving the firm's resilience. We found evidence that structural capital contributes to build both proactive and reactive resilience while relational capital does not. Furthermore, it is worth noting that most of firms have a contingency plan for potential disruptions. The Catalan agro-food system has had to respond to the basic requirements to feed a confined population. Hence, it has shown its capacity to face such an unexpected event, and with the responsibility of feeding the population. The resilience of firms to the pandemic is a key prerequisite to ensure the sustainability of agro-food sector. To reduce the effects of the pandemic, different actors have found a new market window through digital innovation, with online sales platforms and home delivery. The experience and the response of the sector by undertaking online sales could therefore be the beginning of a new era for the agro-food sector. The policy response has also provided several measures that help ensure the continued functioning of supply chain.

Last but not least, some limitations are identified in this study. The limited participation of supply chain actors in the evaluation process might reveal some constraints regarding the generalizability of results. Thus, future research might consider a wider sample of actors to improve the significance and robustness of our empirical findings.

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**Table 1.** Descriptive statistics

<b>Scales</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>Standard Deviation</b>
Marketing Channel Diversity	1.00	6.00	2.99	1.60
Firm Size	1.00	6.00	2.88	1.32
Proactive Resilience	1.50	10.00	7.04	1.54
Reactive Resilience	2.00	9.20	6.57	1.43
Structural Capital	1.25	10.00	5.75	1.97
Relational capital	0.00	8.70	4.42	1.59

**Table 2. Profile of Respondents**

<b>Supply Chain Stage</b>	<b>Percentage (%)</b>
Primary Sector	53.06
Processing industry	36.74
Wholesalers	5.10
Retailers including supermarkets	5.10
<b>Organizational size (numbers of employee)</b>	
<9	50.00
10 to 49	25.58
50 to 199	11.63
200 to 499	4.65
>500	8.14
<b>Annual income</b>	
>0.5M€	30.24
0.5-5M€	38.37
5-10M€	5.81
10-50M€	13.95
>50M€	11.63
<b>Gender</b>	
Male	69.06
Female	30.91
<b>Age</b>	
<35 years	5.45
35 to 49 years	25.45
50 to 64 years	67.27
>65 years	1.82

**Table 3.** Scale validity and reliability measurement

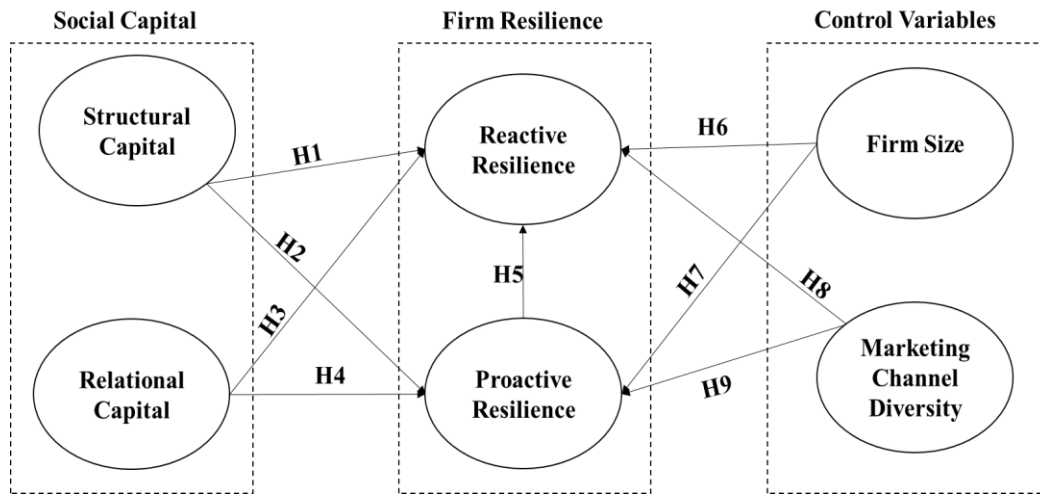
<b>Latent constructs</b>	<b>Std. factor loading</b>	<b>t-values</b>
<b>Structural Capital (CR=0.883, AVE=0.656)</b>		
Spending time together in social occasions with key supply chain partners.	0.848***	20.680
Maintain a close social relationship with key supply chain partners.	0.701***	11.239
Promoting an interaction between the personnel across different levels of firm and key supply chain partners.	0.868***	22.957
Promoting an interaction across different operations (logistics and marketing) within firm and between key supply chain partners.	0.812***	17.481
<b>Relational Capital (CR=0.723, AVE=0.472)</b>		
Relationship with key supply chain partners (associations) is characterized by mutual support at multiple levels.	0.554***	5.568
Relationship with key supply chain partners is characterized by mutual collaboration.	0.658***	6.667
Relationship with key supply chain partners is characterized by high levels of mutual benefit.	0.823***	8.040
<b>Proactive Resilience(CR=0.834, AVE=0.559)</b>		
Creating internal awareness for disruptions and trying to drive this awareness to employees.	0.601***	7.210
Analyzing and assessing both probability and impact of potential disruptions	0.764***	12.663
Improving disruption prevention capabilities.	0.786***	14.572
Engaging in contingency planning to prepare for potential disruptions.	0.821***	16.590
<b>Reactive Resilience (CR=0.902, AVE=0. 0.649)</b>		
Being able to quickly recognize that there is a threatening situation	0.780***	16.623
Being able to gather and interpret information of cues to gauge the magnitude, location, and causes of the disruption.	0.746***	14.209
Being able to quickly identify, formulate, and evaluate a set of possible responses to disruption.	0.934***	39.519
Being able to quickly organize a formal response team of key personnel, both on-site and at corporate level.	0.809***	19.188
Being very successful at dealing with crises, including addressing public relations issues.	0.744***	13.990

Note: \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% respectively. **CR:** composite reliability; **AVE:** average variance extracted.

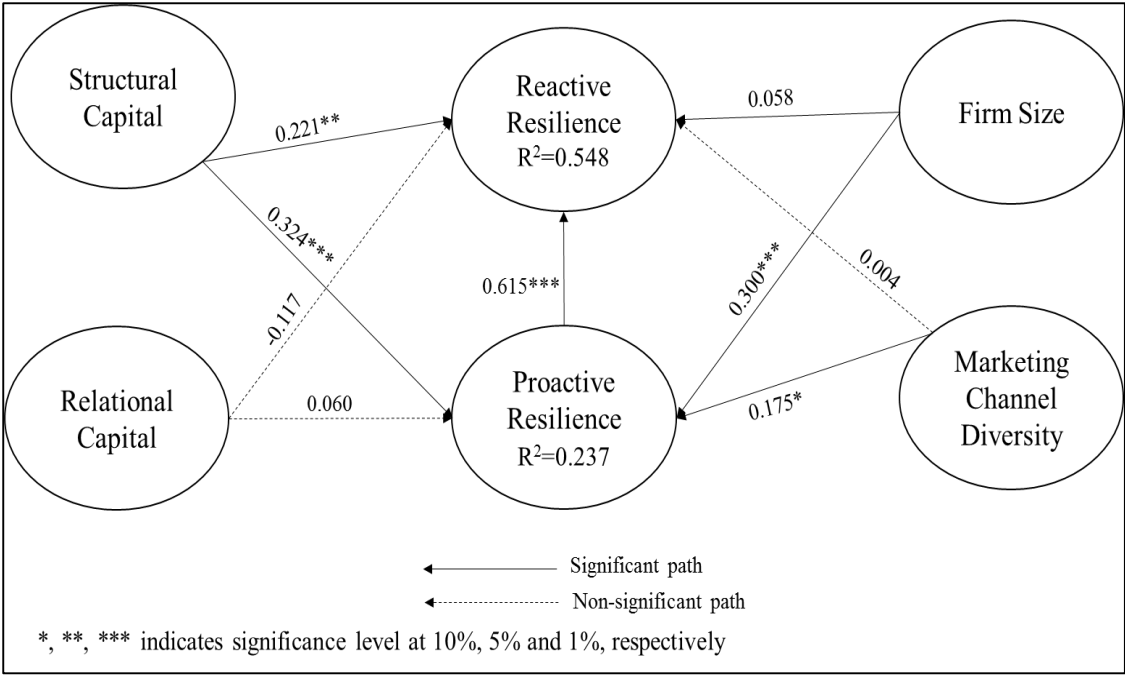
**Table 4.** Structural Equation Model (SEM) results to explain supply chain resilience

<b>Paths</b>	<b>Path Coefficients</b>	<b>Std. Error</b>	<b>Hypothesis</b>	<b>Goodness-of-Fit Statistics</b>
Structural capital → Reactive resilience	0.221**	0.099	H1 supported	NC = 3.988 RMSEA= 0.096 NNFI= 0.846 CFI= 0.871 CD=0.980
Structural capital → Proactive resilience	0.324***	0.109	H2 supported	
Relational capital → Reactive resilience	-0.117	0.098	H3 not supported	
Relational capital → Proactive resilience	0.060	0.123	H4 not supported	
Proactive resilience → Reactive resilience	0.615***	0.098	H5 supported	
Firm size → Reactive resilience	0.058	0.092	H6 not supported	
Firm size → Proactive resilience	0.300***	0.101	H7 supported	
Marketing channel diversity → Reactive resilience	0.004	0.088	H8 not supported	
Marketing channel diversity → Proactive resilience	0.175	0.105	H9 supported	

Note: \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% respectively. **NC**: Normed chi-square; **RMSEA**: Root mean square error of approximation; **CFI**: Comparative-fit-index (CFI); **NNFI**: Non-normed-fit-index; **CD**: coefficient of determination.



**Figure 1.** Conceptual Framework and Hypotheses



**Figure 2.** Structural equation model results