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# Dynamism, disruption orientation, and resilience in the supply chain and the impacts on financial performance: A dynamic capabilities perspective

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ABSTRACT

Supply chains are becoming increasingly dynamic in response to changing business environments and technology. This has created challenges in managing the flow of materials and created greater risk of disruption. As such this study investigates the impact of such dynamism on disruption orientations, resilience, and financial performance. Herein an integrated conceptual framework is developed and then tested using survey data from a cross section of 241 Chinese companies and structural equation modelling. The results of the study reveal that supply chain dynamism has a significant positive effect on supply chain disruption orientation and supply chain resilience. Supply chain resilience is also affected by supply chain disruption orientation. However, the financial performance impacts of supply chain disruption orientation are strictly through supply chain resilience.

## 1. Introduction

Late in 2018 the Trump administration abruptly imposed tariffs on a number of Chinese products, which were reciprocated by the Chinese. The result was a significant rise of uncertainty and a search for new suppliers by many firms (Fujita, 2019). In 2010 Seagate found its ability to fill orders for hard disk drives impaired by the demolition of two of its plants by flooding from a Tsunami in Thailand (Powell, 2011). This unforeseen reduction in the flow of goods resulted in a global under supply of hard drives in the amount of 29% causing, among other things, Hewlett-Packard's earnings and market valuation to fall (Powell, 2011). Hampton Creek and Theranos each transitioned from fast growing market darling to discredited organization in short order as fraud was revealed resulting in changes to capital and material/service flows alike (Griffith, 2017). Pandora reshaped how recorded music was consumed and Square reshaped credit card processing; both in very short durations of time (Downes and Nunes, 2013). In summary, these few examples show how supply chains are dynamic and the flow of materials uncertain. Inferred from them is the importance of adjusting to new scenarios impacting resource and material flows.

Orchestrating the flow of resources has become increasingly challenging for managers, in part due to increased environmental dynamism (Christopher and Lee, 2004). For example, firms are introducing products at faster rates (Closs et al., 2008; Jacobs and Swink, 2011) in order to influence the environment in which they do business (Teece, 2007) and thus driving an increase in supply chain dynamism as these same firms rely upon trading partners to help deliver the new products (Zhou and Benton, 2007). At the same time that product lifecycles are shortening and product introduction rates increasing, supply chains are lengthening geographically and via outsourcing to maintain cost competitiveness. However, extension of the supply chain exposes the focal firm to a greater potential for the disruption of the flow of materials (Blackhurst et al., 2005, 2011); disruptions being unanticipated events breaking the regular flow of goods or services (Craighead et al., 2007). Disruptions, should they occur, can cause negative financial consequences for the firms involved (Bode and Wagner, 2015; Dabhilkar et al., 2016; Golgeci and Ponomarov, 2013; Hendricks and Singhal, 2005). As such, in the interest of maintaining high performance, managers are advised to implement various mitigations (Revilla and Saenz, 2017; Sodhi et al., 2012), e.g. cultivating a supply chain disruption orientation (SCDO) and bolstering supply chain resilience (SCR), to improve the firm's ability to absorb disruptions and rapidly return to stable conditions (Blackhurst et al., 2011; Hohenstein et al., 2015; Pettit et al., 2013; Sheffi and Rice, 2005). Therefore, it is important for managers to understand how to mitigate the effects of supply chain dynamism (Ambulkar et al., 2015; Blackhurst et al., 2011; Zhou and

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**Table 1**
Literature overview on supply chain dynamism, supply chain disruption orientation and supply chain resilience.

| Topic areas | Key previous studies |
|---|---|
| *Supply chain dynamism* | |
| Concept of supply chain dynamism | Zhou and Benton (2007) investigated the relationship between information sharing, supply chain dynamism and supply chain practice (supply chain planning, JIT production, and delivery practices). They found that effective information sharing mediates the impact of supply chain dynamism on supply chain practice. |
| Moderating effect of supply chain dynamism | Lee et al. (2016) examined the moderating effect of supply chain dynamism on the relationship between supply chain integration and logistics performance. Their findings provided empirical evidence of the moderating effect of supply chain dynamism. |
| ***Supply chain disruption orientation*** | |
| Concept of supply chain disruption orientation | Bode et al. (2011) introduced the concept of supply chain disruption orientation. They found that supply chain disruption oriented firms are more likely to execute specific and effective responses for reducing the probability or impact of future supply chain disruptions. |
| Factors that contribute to firm resilience to supply chain disruptions | Ambulkar et al. (2015) investigated the relationship between supply chain disruption orientation, resource reconfiguration and firm resilience. They found that supply chain disruption oriented firms require the ability to reconfigure resources or have a risk management resource infrastructure to develop resilience. |
| ***Supply chain resilience*** | |
| Literature review | Ponomarov and Holcomb (2009) developed a conceptual framework that examines the dimensions of supply chain resilience, its antecedents and its consequences through a systematic review of the literature. |
| Literature review | By conducting a systematic literature review, Ali et al. (2017) employed a concept mapping approach to clarify the definitions of supply chain resilience, and its essential elements and managerial practices. |
| Literature review | Kamalahmadi and Parast (2016) investigated the research development in supply chain resilience by conducting a comprehensive literature review. Their study provided a platform that identifies the existing state of the work, gaps in current research, and future directions on the topic. |
| Antecedents to supply chain resilience | Golgeci and Ponomarov (2013) investigated the relationships between firm innovativeness, innovation magnitude, disruption severity, and supply chain resilience. They found that firm innovativeness and innovation magnitude are positively associated with supply chain resilience. |

Benton, 2007).

To date, published research has largely focused on identifying antecedent factors affecting resilience to supply chain disruptions, factors such as: supply chain visibility (Brandon-Jones et al., 2014), risk taking propensity and supply chain security practices (Park et al., 2016), resource reconfiguration and risk management infrastructure (Ambulkar et al., 2015), supply chain collaboration (Scholten and Schilder, 2015), supply chain mitigation capabilities and supply chain design characteristics (Craighead et al., 2007), uncertainty, regulatory focus and level of risk (Cantor et al., 2014), and firm innovativeness (Golgeci and Ponomarov, 2013). While there is an interesting and insightful paper from the management literature by Lengnick-Hall and Beck (2005) that considers the contrast between adaptation and robust transformation approaches to environmental change within organizations, little attention has been devoted to the effects of supply chain dynamism (Bode et al., 2011; Johnson et al., 2013; Lee et al., 2016). Consequently, this study aims to develop and empirically test an integrated conceptual framework rooted in the Dynamic Capabilities View (DCV) that investigates (1) the effect of supply chain dynamism on SCDO and SCR; and (2) the relationships among SCDO, SCR, and financial performance, more specifically the mediating effect of SCR. The pursuit of the objective leads to three key contributions that are detailed following.

Supply chain dynamism, defined as “the pace of changes in both products and processes” (Zhou and Benton, 2007, p.1351), has become increasingly important for firms to manage (Lee et al., 2016) because it can influence coordination among supply chain partners (Zhou and Benton, 2007). Furthermore, given the complexity and dynamic nature of supply chains (Wu et al., 2007), every activity that a supply chain member conducts has an inherent risk of unexpected disturbances elsewhere in the supply chain that may lead to financial losses and, in some cases, firm demise (Skipper and Hanna, 2009; Scholten et al., 2014). This suggests that the firm and the environment in which it is ensconced are in a symbiotic relationship (Teece, 2007). If this is so then it is important to understand the relationships of environmental inputs such as supply chain dynamism and firm attributes such as disruption orientation and resilience. Managers and researchers are aware that a better understanding of supply chain dynamism is needed (Lee et al., 2016; Zhou and Benton, 2007) and as such a contribution of this study is the investigation of the direct effects of supply chain dynamism on the implementation of supply chain initiatives (such as disruption orientation and resilience) and performance.

Recently there has been increasing interest from both academics and practitioners in understanding the management of supply chain disruptions through the development of a SCDO and SCR (Ambulkar et al., 2015; Blackhurst et al., 2011; Scholten and Schilder, 2015; Stevenson and Busby, 2015). A SCDO is characterized as the firm's recognition and awareness of pending disruptions and how firms analyse and learn from prior disruptions (Ambulkar et al., 2015; Bode et al., 2011). SCR emerges as a dynamic capability hypothesized as enabling firms to better manage disruptions and therefore maintain higher performance through the continuance of product and service deliveries to customers (Brusset and Teller, 2017; Golgeci and Ponomarov, 2013; Juttner and Maklan, 2011; Scholten et al., 2014). The present study examines the SCDO–SCR relationship and ramifications for financial performance.

In this study, we seek to understand the mediating role of SCR in the relationships between SCDO and financial performance, which establishes a bridge between our theoretical findings on SCR and their implications for practice. To survive in an increasingly uncertain business environment, firms may focus on building SCR capabilities to mitigate the negative impact of disruptions (Ambulkar et al., 2015; Dabhilkar et al., 2016; Juttner and Maklan, 2011; Scholten and Schilder, 2015; Tukamuhabwa et al., 2015). SCR has been recognized as a dynamic capability enabling firms to handle unforeseen and unquantifiable events. However, the present study will illuminate whether there is a mediating role for SCR. Understanding this relationship has implications for resource allocations. Specifically in the present context, where should investments be made in order to improve firm financial performance?

## 2. Theoretical constructs and literature review

This section provides definitions of three key topic areas (i.e. supply chain dynamism, supply chain disruption orientation and supply chain resilience), followed by a brief review of the related state-of-the-art literature (see Table 1). Table 1 also highlights the gaps this study fills in the literature.

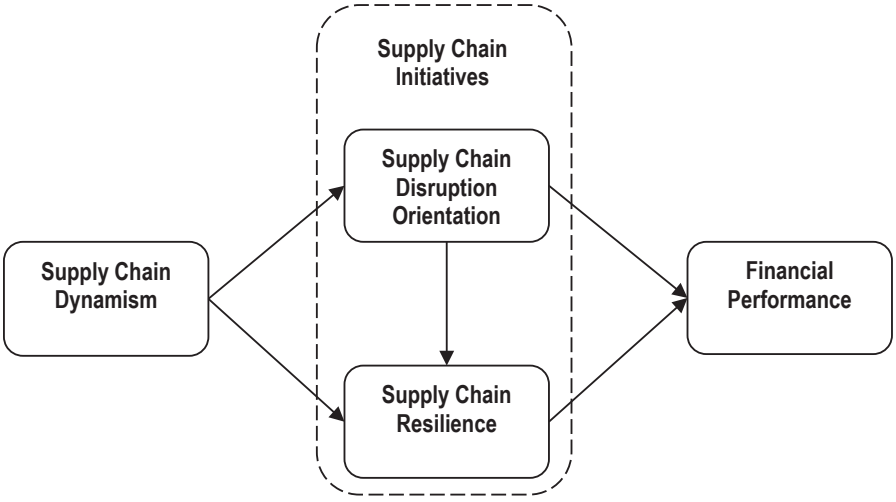


**Fig. 1.** Theoretical model.

### 2.1. Supply chain dynamism

Business environmental dynamism refers to volatility or unpredictability of changes within an industry or factors affecting the industry (Dess and Beard, 1984; Miller and Friesen, 1983). These changes can arise from many sources, including the rate of change and innovation in the firm's principal industries; unpredictable changes in products and services, technologies; and demand for new products and services in the market (Lawrence and Lorsch, 1967; Miller and Friesen, 1983). In highly uncertain and turbulent business environments, supply chains may encounter different rates of change, which have been shown to have a significant effect on supply chain operations (Fisher, 1997; Zhou and Benton, 2007). Following the work of Zhou and Benton (2007), in the present study *supply chain dynamism* is defined as the pace of change in both products and processes. It can be measured by the fraction of revenue derived from new products, the degree of the innovation frequency for products and services, and the innovation rate of operating processes (Zhou and Benton, 2007). Gaining a better understanding of the levels of supply chain dynamism has become increasingly important for firms to develop more effective supply chain initiatives (Lee et al., 2016; Wu et al., 2007).

### 2.2. Supply chain disruption orientation (SCDO)

Supply chain disruptions are events that are characterized by high uncertainty and interrupt the regular flow of goods and services within the supply chain (Blackhurst et al., 2011; Bode et al., 2011; Craighead et al., 2007). When facing supply chain disruptions, firms may respond by renewing or realigning risk management infrastructure and learning from prior disruptions to mitigate threats and exploit new opportunities (Ambulkar et al., 2015), which will enable the firms to develop a strong SCDO. Following the work of Bode et al. (2011, p.837), in the present study *supply chain disruption orientation* is defined as "a firm's general awareness and consciousness of, concerns about, seriousness toward, and recognition of opportunity to learn from supply chain disruptions". In a highly dynamic environment, firms with a SCDO are aware that disruptions can occur and are motivated to learn from prior disruptions (Ambulkar et al., 2015). More specifically, Bode et al. (2011) stated that in highly competitive environments supply chain disruption oriented firms can learn from their disruption experiences and proactively build capabilities to manage supply chain disruptions.

### 2.3. Supply chain resilience (SCR)

In today's turbulent and uncertain environment, it is important for firms to build resilient supply chains to manage unforeseen and unquantifiable risks (Ali et al., 2017; Bhamra et al., 2011; Sheffi and Rice, 2005). Following the work of Ponomarov and Holcomb (2009, p.131) the present study defines *supply chain resilience* as an "adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function". Resilience is the capability to respond to unexpected disturbances and disruptions (Kamalahmadi and Parast, 2016). Prior research (e.g. Golgeci and Ponomarov, 2013; Ponomarov and Holcomb, 2009; Sheffi and Rice, 2005) has viewed SCR as a dynamic capability enabling the supply chain to effectively adapt, respond, and recover from disruptions (Blackhurst et al., 2011; Juttner and Maklan, 2011). A resilient supply chain absorbs unexpected disruptions and restores the supply chain to a robust state of operation that can lead to competitive advantages (Ali et al., 2017; Hohenstein et al., 2015; Kamalahmadi and Parast, 2016; Pereira et al., 2014; Pettit et al., 2013).

## 3. Conceptual framework and research hypotheses development

While previous research has viewed resiliency as the key to a firm's ability to manage supply chain disruptions, there is limited research on how firms develop resilience to supply chain dynamism and disruptions (Ambulkar et al., 2015; Blackhurst et al., 2011; Juttner and Maklan, 2011). The present study draws upon the DCV to propose an integrated conceptual framework (see Fig. 1) and empirically test the relationships among supply chain dynamism, SCDO, SCR, and financial performance.

### 3.1. Dynamic capabilities view (DCV)

The dynamic capabilities view (DCV) extends the resource-based view (Barney, 1991) by considering the refreshing of the current stock of resources (Eisenhardt and Martin, 2000; Teece, 2007). The DCV suggests that a firm seeking sustainable competitive advantage should develop new or reconfigure existing capabilities and resources to address emergent opportunities (Eisenhardt and Martin, 2000). A dynamic capability is "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997, pp.516) and is embedded as a process or set of processes associated with resource manipulation (Eisenhardt and Martin, 2000). More specifically, a dynamic capability is a pattern of activity through which the organization modifies operating routines for purposes of improved effectiveness (Zollo and Winter 2002). Previous research has positioned SCR as a dynamic capability to prepare for unavoidable risk events and to respond to and recover from

unexpected disruptions (Brusset and Teller, 2017; Dabhilkar et al., 2016; Golgeci and Ponomarov, 2013; Ponomarov and Holcomb, 2009; Purvis et al., 2016; Scholten et al., 2014). As a dynamic capability, SCR enables firms to absorb the negative effects from a range of different risk sources (Teece, 2007).

### 3.2. The effect of supply chain dynamism on SCDO and SCR

Businesses are developing products that are increasingly differentiated at an increasing rate (Jacobs, 2013). In fact, it has been reported that there are 1.7 new products replacing every one product retired (Hoole, 2006). Furthermore, this is in the context of decreasing product lifecycles (Helfat and Eisenhardt, 2004) that are accentuating the challenges faced by firms. The introductions of new products and the increased rate of innovation require that firms respond in ways that are unique to this environmental context (Fisher, 1997). Developing a disruption orientation and resilience capabilities are two potentially useful organizational capabilities for responding to the dynamism with its supply chain to which a firm is exposed. We contextualize these capabilities as mechanisms of robust transformation (Lengnick-Hall and Beck, 2005) as the changes in the environment are ongoing.

Both SCDO and SCR require organizational routines that can be used as tools to (re)configure resources of the firm (Eisenhardt and Martin, 2000). The resources could be production equipment, inventory, or even the processes associated with alliances and material acquisition. These capabilities may be well-considered stable processes or in highly dynamic cases may even be ad hoc or experimental in nature. In either case, an important aspect is the organizational learning that takes place associated with the reconfiguration of assets (Benner and Tushman, 2003).

SCDO includes vigilance activities. Vigilance has the benefit of increasing the time a firm has to respond to a change; it serves in an early warning type of capacity. There are many forms of vigilance including but not limited to the monitoring of patents or industry developments, monitoring news events in specific geographic regions, or even performing audits and on-site visits. Importantly, from a dynamic capability standpoint, the approaches to and technology for monitoring are in a constant state of flux. Another facet of a disruption orientation is the analysis of a disruption after it has occurred. The primary rationale for conducting such an analysis is the organizational learning that can be gained.

SCR entails rapidly reconfiguring operations after a disruption has occurred. SCR also can entail responding to volume spikes (Aslam et al., 2018). Either suggests that operations could be reconfigured in a plethora of ways depending on the needs of the organization. Another aspect is the financial preparedness to weather a disruption. The ability to be resilient, as manifested by these attributes, could take a very large number of forms and may not be the same every time. Hence, SCR is by its nature a dynamic capability.

Hence, it can be seen from the logic presented above that SCR and a disruption orientation are plausible organizational responses to supply chain dynamism. Since it has been suggested that gaining a better understanding of supply chain dynamism has become important for firms to develop effective supply chain initiatives (Lee et al., 2016; Zhou and Benton, 2007), we hypothesize that:

**H1.** Higher levels of supply chain dynamism will be associated with higher levels of SCDO.

**H2.** Higher levels of supply chain dynamism will be associated with higher levels of SCR.

### 3.3. The effect of SCDO on SCR

Previous research (e.g. Helfat and Peteraf, 2003) has suggested that firms that learn from the external business environment are better able to develop the dynamic capabilities that improve responsiveness. In today's globalized and highly competitive environment firms with a high SCDO, which is characterized as the firm's recognition and awareness of pending disruptions and how firms analyse and learn from prior disruptions, are more likely to build SCR capabilities (Bode et al., 2011). SCDO oriented firms strive to learn from their past supply chain disruption experiences and proactively build SCR capabilities that enable effective responses to supply chain disruptions (Ambulkar et al., 2015; Bode et al., 2011). Bode et al. (2011) argue that cultivating a strong SCDO, which includes a preoccupation with preventing failure, continuous improvement processes, and a commitment to learn from disruptions will lead to a stronger motivation to act in the wake of a disruption. This argument suggests that firms with a high SCDO can employ more proactive approaches to restoring stability more rapidly (Bode et al., 2011). Accordingly, we expect that SCDO acts as an important enabler of SCR and as such offer the following hypothesis:

**H3.** Higher levels of SCDO will be associated with higher levels of SCR.

### 3.4. The effects of SCDO and SCR on performance

Dynamic capabilities facilitate ongoing high performance (Teece et al., 1997). They do so through the adjustment of the resource mix for the purposes of securing or maintaining competitive advantage. In this way they can sustain a high level of performance over an extended time (Bititci et al., 2011; Witcher et al., 2008). The high level of performance may then result in financial benefits (Blackhurst et al., 2011; Craighead et al., 2007; Hohenstein et al., 2015).

Pertaining to the above-mentioned property of dynamic capabilities leading to financial benefit, a specific rationale for SCDO and SCR follows. The SCDO entails continuously monitoring the environment for supply and demand shifts. When this is coupled with the capability to rapidly respond resident within SCR, market gains may be realized (Lee et al., 2016). In a dynamic way, SCR helps firms manage change effectively thereby enabling operations to be restored to the previous or even improved performance level (Christopher and Peck, 2004; Pereira et al., 2014; Scholten et al., 2014; Sheffi and Rice, 2005). It is possible that the firm's orientation toward disruption drives its motivation to quickly and precisely respond to business environment changes (Bode et al., 2011). Indeed firms that cultivate a strong SCDO may be able to achieve financial benefits through enhancing the resiliency of their supply chain (Blackhurst et al., 2011; Craighead et al., 2007; Hohenstein et al., 2015). In this way, SCDO impacts SCR and financial performance (Bode et al., 2011; Manuj and Mentzer, 2008) both directly and through SCR as a mediator. Given the foregoing, we offer the following hypotheses:

**H4.** Higher levels of SCDO will be associated with better financial performance.

**H5.** Higher levels of SCR will be associated with better financial performance.

Given the set of research hypotheses (H3-H5) and the tenets of DCV, our overall expectation is that SCR acts as a mediator on the relationship between SCDO and financial performance. The firm's orientation toward supply chain disruption drives its motivation to quickly and precisely respond to changes in the business environment, which in turn is linked to superior firm performance (Bode et al., 2011). Although supply chain disruptions are inevitable, the firms that cultivate a strong SCDO may be able to achieve financial benefits through enhancing the resiliency of their supply chain (Blackhurst et al., 2011; Craighead et al., 2007; Hohenstein et al., 2015). This argument suggests that a strong SCDO leads to a stronger motivation to develop resilient supply chains; however, this resiliency characteristic constitutes a mechanism through which SCDO can materialise as financial performance. As such we hypothesize that:

**H6.** SCR mediates the relationship between SCDO and financial performance.

## 4. Research method

### 4.1. Data collection

For this study data from the Chinese manufacturing industry was gathered February–June 2017. Following the approach recommended by Zhao et al. (2006) seven regions were used as the sample pool including Pearl River Delta, Yangtze River Delta, Bohai Sea Economic Area, Northeast China, Central China, Southwest China, and Northwest China. The sample captured the major geographical regions in China and represent the different stages of economic development within the country (Zhao et al., 2006).

Consistent with prior studies that conducted survey data collection in China, a random sample from the government directories of firms in China's manufacturing industry provided by Provincial Economic and Information Technology Commission in the seven regions was used (Li et al., 2010). To obtain a representative sample 1000 manufacturing firms from the government directories in these geographical regions were selected. Contact was made with key informants by telephone and email, before sending out the questionnaires, aimed at obtaining preliminary agreement to participate in the research (Yu et al., 2013). The questionnaires with a cover letter explaining the main purpose of the research and assuring confidentiality were sent to 890 firms that agreed to participate. After several telephone and email reminders 257 questionnaires were received and of those 16 were discarded because of significant missing data leaving 241 useable questionnaires. The effective response rate was 27.08%.

Table 2 provides a summary of demographic characteristics of respondents. As shown in Table 2, most of the informants held a position such as CEO, president, vice president, director, or manager, and had been in their current position for more than five years. Thus, based on position and tenure it is reasonable to expect that the informants have sufficient knowledge to complete the survey. Table 2 also indicates that data were obtained from respondents in a wide variety of manufacturing industries and the respondents represent a wide variety of backgrounds in terms of number of employees and firm ownership.

**Table 2**
Demographic characteristics of respondents (n = 241).

| | Number of firms | Percent (%) |
|---|---|---|
| Industries | | |
| Automobile | 74 | 30.7 |
| Chemicals and petrochemicals | 25 | 10.4 |
| Electronics and electrical | 30 | 12.4 |
| Fabricated metal product | 15 | 6.2 |
| Food, beverage and alcohol | 33 | 13.7 |
| Rubber and plastics | 6 | 2.5 |
| Textiles and apparel | 11 | 4.6 |
| Others | 47 | 19.5 |
| **Number of employees** | | |
| 1–100 | 46 | 19.1 |
| 101–200 | 37 | 15.4 |
| 201–500 | 32 | 13.3 |
| 501–1000 | 21 | 8.7 |
| 1001–3000 | 43 | 17.8 |
| > 3000 | 62 | 25.7 |
| **Annual sales (in million Yuan)** | | |
| Below 10 | 24 | 10.0 |
| 10–50 | 38 | 15.8 |
| 50–100 | 25 | 10.4 |
| 100–500 | 41 | 17.0 |
| 500–1000 | 31 | 12.9 |
| Above 1000 | 82 | 34.0 |
| **Firm ownership** | | |
| State-owned manufacturer | 74 | 30.7 |
| Private Chinese manufacturer | 109 | 45.2 |
| Wholly foreign-owned manufacturer | 25 | 10.4 |
| Joint venture manufacturer | 33 | 13.7 |
| **Respondent location (geographical regions)** | | |
| Pearl River Delta | 21 | 8.7 |
| Yangtze River Delta | 21 | 8.7 |
| Bohai Sea Economic Area | 50 | 20.7 |
| Northeast China | 4 | 1.7 |
| Central China | 36 | 14.9 |
| Southwest China | 93 | 38.6 |
| Northwest China | 16 | 6.6 |
| **Years in current position** | | |
| ≤5 | 109 | 45.2 |
| 6–10 | 59 | 24.5 |
| > 10 | 73 | 30.3 |
| **Job titles** | | |
| President/Chief executive officer (CEO) | 13 | 5.4 |
| Vice President | 17 | 7.1 |
| Director | 11 | 4.6 |
| Manager | 119 | 49.4 |
| Other senior executive | 81 | 33.6 |

### 4.2. Questionnaire design

Following the guidance recommended in previous studies (e.g. Flynn et al., 2010), several approaches to improve content validity and reliability were employed. First, the English version of the questionnaire was translated into Chinese followed by a back-translation to ensure conceptual equivalence. The back-translated English version was checked against the original English version which ensured the reliability of the questionnaire survey. Second, even though the measurement scales were used prior and demonstrated to be valid, due to the unique characteristics of the Chinese manufacturing industry (Zhao et al., 2006) the existing measurement scales were modified in minor ways in order to account for language and cultural differences. Third, content validity of the measurement scales was further established through a pilot test with academic and industry experts. To assess the content validity of the scales, four academic researchers critiqued the measurement instruments for relevance and clarity. Further, a pilot test with senior executives from four manufacturing firms using semi-structured interviews was conducted and based on the feedback from both academics and industry practitioners, redundant and ambiguous items were eliminated or modified.

### 4.3. Measures and control variables

The measurement items used in this study were adapted from the literature and are reported in Table 3. The measures for *supply chain dynamism* were adapted from Zhou and Benton (2007) and comprise three items (questions SCD1 to SCD3 given in Table 3): new products account for a high fraction of total revenue, products/services are innovated frequently, and the high innovation rate of operating processes. The measures for *supply chain disruption orientation* were adapted from Bode et al. (2011) and comprise four items (questions SCDO1 to SCDO4 given in Table 3) that reflect the zeal to learn from supply chain disruptions and a state of permanent alertness and dynamic awareness. A 7-point scale (strongly disagree–strongly agree) was used to capture respondents' level of agreement with the statements made in each item: we feel the need to be alert for possible supply chain disruptions at all times; we recognize that supply chain disruptions are always looming, we think a lot about how a supply chain disruption could have been avoided; and after a supply chain disruption has occurred, it is analysed thoroughly. The measures for *supply chain resilience* were adapted from Golgeci and Ponomarov (2013). This six-item scale (questions SCR1 to SCR6) assesses a firm's ability to adequately respond to unexpected disruptions; quickly return to original state after being disrupted; move to a new and more desirable state after being disrupted; well prepared to deal with financial outcomes of supply chain disruptions; maintain a desired level of control over structure and function at the time of

**Table 3**
EFA of supply chain dynamism, supply chain disruption orientation, supply chain resilience and financial performance.

| Measurement items | F1 | F2 | F3 | F4 |
|---|---|---|---|---|
| **1. Financial performance** (Flynn et al., 2010). *Please evaluate in the scale below in terms of financial performance how your firm compares to your major industrial competitors over the last three years [1 = much worse, 7 = much better].* | | | | |
| FP1: Growth in return on sales | **0.822** | 0.193 | 0.136 | 0.088 |
| FP2: Growth in profit | **0.900** | 0.122 | 0.063 | 0.071 |
| FP3: Growth in market share | **0.833** | 0.080 | 0.157 | 0.100 |
| FP4: Return on investment (ROI) | **0.908** | 0.210 | 0.091 | 0.068 |
| FP5: Growth in ROI | **0.901** | 0.213 | 0.139 | 0.027 |
| FP6: Growth in return on assets | **0.860** | 0.193 | 0.118 | 0.029 |
| **2. Supply chain resilience** (Golgeci and Ponomarov, 2013). *Please indicate the degree to which you disagree or agree with the following statements relating to supply chain resilience [1 = strongly disagree, 7 = strongly agree].* | | | | |
| SCR1: Our company's supply chain is able to adequately respond to unexpected disruptions by quickly restoring its product flow | 0.153 | **0.711** | 0.345 | 0.100 |
| SCR2: Our company's supply chain can quickly return to its original state after being disrupted | 0.172 | **0.811** | 0.245 | 0.055 |
| SCR3: Our company's supply chain can move to a new, more desirable state after being disrupted | 0.249 | **0.796** | 0.030 | 0.078 |
| SCR4: Our company's supply chain is well prepared to deal with financial outcomes of supply chain disruptions | 0.183 | **0.747** | 0.280 | 0.026 |
| SCR5: Our company's supply chain has the ability to maintain a desired level of control over structure and function at the time of disruption | 0.111 | **0.816** | 0.230 | 0.119 |
| SCR6: Our company's supply chain has the ability to extract meaning and useful knowledge from disruptions and unexpected events | 0.171 | **0.703** | 0.311 | 0.187 |
| **3. Supply chain disruption orientation** (Bode et al., 2011). *Please indicate the degree to which you disagree or agree with the following statements referring to your supply chain disruption orientation [1 = strongly disagree, 7 = strongly agree].* | | | | |
| SCDO1: We feel the need to be alert for possible supply chain disruptions at all times | 0.125 | 0.217 | **0.809** | 0.082 |
| SCDO2: We recognize that supply chain disruptions are always looming | 0.129 | 0.214 | **0.820** | 0.041 |
| SCDO3: We think a lot about how a supply chain disruption could have been avoided | 0.161 | 0.412 | **0.761** | 0.067 |
| SCDO4: After a supply chain disruption has occurred, it is analysed thoroughly | 0.191 | 0.416 | **0.724** | 0.135 |
| **4. Supply chain dynamism** (Zhou and Benton, 2007). *Please indicate the degree to which you disagree or agree with the following statements relating to supply chain dynamism [1 = strongly disagree, 7 = strongly agree].* | | | | |
| SCD1: New products account for a high fraction of total revenue | 0.107 | 0.113 | −0.069 | **0.792** |
| SCD2: Products and services are innovated frequently | 0.028 | 0.102 | 0.106 | **0.879** |
| SCD3: The innovation rate of operating processes is high | 0.095 | 0.098 | 0.205 | **0.789** |
| **Eigenvalues** | 7.987 | 3.010 | 1.866 | 1.303 |
| **% of variance** | 42.035 | 15.843 | 9.821 | 6.857 |
| **Cumulative explained variance (%)** | 42.035 | 57.879 | 67.699 | 74.556 |

disruption; and extract meaning and useful knowledge from disruptions and unexpected events. All these items above were measured using a 7-point scale, ranging from 1 “strongly disagree” to 7 “strongly agree”.

Firm financial performance refers to “how well a firm fulfils its financial goals compared with the firm's primary competitors” (Cao and Zhang, 2010, p.167). In this study, the measures for *financial performance* were adapted from Flynn et al. (2010) and include growth in return on sales, growth in profit, growth in market share, return on investment (ROI), growth in ROI, and growth in return on assets (questions FP1 to FP6). These measures have been widely used in previous studies (e.g. Chavez et al., 2017; Narasimhan and Kim, 2002; Vickery et al., 2003; Yu et al., 2013) because they are “primary yardsticks for most stakeholders” (Cao and Zhang, 2010, p.167). Effectiveness of SCR should be reflected on such financial indicators. Consistent with previous studies, respondents were asked to evaluate the relative competitive performance over the past three years by making a comparison with their main competitors in the industry. The indicators were measured using a seven-point scale, from 1 “much worse than your major competitors” to 7 “much better than your major competitors”.

*Industry type* and *firm size* were used as control variables in the analyses. First, the type of industry was controlled because firms in the different manufacturing industries may develop different levels of supply chain initiatives to handle and recover from unexpected disruptions and thus achieve different levels of performance. As shown in Table 2, a wide variety of manufacturing industries are represented, with 30.7% of the respondent firms in the automobile industry sector, 13.7% in the food, beverage and alcohol industries, 12.4% of the respondents representing electronics and electrical firms, and 10.4% of the firms coming from the chemicals and petrochemicals industries. They are characterized by dummy variables for industry type; dummy variable Industry1 refers to automobile; Industry2 refers to food, beverage and alcohol; Industry3 refers to electronics and electrical; and Industry4 refers to chemicals and petrochemicals. The base group is other industries (Huo et al., 2014). Second, firm size, as measured by the number of employees (see Table 2) was controlled because larger firms may have more resources for implementing more effective supply chain initiatives in dynamic environments and thus may achieve better performance than small firms.

### 4.4. Non-response bias and common-method bias

Non-response bias was assessed using the method recommended by Armstrong and Overton (1977), which compared early and late respondents on two important demographic variables (i.e., number of employees and annual sales). The *t*-test results indicate no significant statistical difference ($p < 0.05$) between the category means for number of employees and annual sales, indicating that non-response bias may not be a concern in this study.

Common method bias was checked because data was from a single respondent per firm using the self-reported questionnaire survey. Harman's single-factor test is arguably the most widely known approach for assessing common method bias in a single-method research design (Podsakoff et al., 2003). Previous research has argued that Harman's single-factor test does not eliminate the possibility of common method bias (Podsakoff et al., 2003). Therefore, besides Harman's single-factor test (see Table 3), two additional approaches were used. First, confirmatory factor analysis (CFA) was applied to Harman's single-factor model in order to further evaluate common method bias. The CFA generated an unacceptable model fit of $\chi^2$/df (1824.646/152) = 12.004, CFI = 0.521, IFI = 0.524, TLI = 0.461, RMSEA = 0.214 and SRMR = 0.202 (Hair et al., 2010; Hu and Bentler, 1999), which was significantly worse than those of the measurement model (see Table 4). Second, to further assess common method bias, two different latent variable models were tested and compared; one measurement model included only the traits (multiple factors) and the other model included both the traits and a method factor (Flynn et al., 2010; Podsakoff et al., 2003; Williams et al., 1989). The fit indices for

**Table 4**
CFA results: reliability and validity.

| Measurement Items | Factor loadings | t-values | α | CR | AVE |
|---|---|---|---|---|---|
| **1. Financial performance** | | | 0.951 | 0.952 | 0.768 |
| FP1 | 0.826 | – | | | |
| FP2 | 0.881 | 17.411 | | | |
| FP3 | 0.804 | 15.032 | | | |
| FP4 | 0.941 | 19.518 | | | |
| FP5 | 0.938 | 19.395 | | | |
| FP6 | 0.858 | 16.672 | | | |
| **2. Supply chain resilience** | | | 0.905 | 0.893 | 0.625 |
| SCR1 | 0.776 | – | | | |
| SCR2 | 0.832 | 13.877 | | | |
| SCR3 | 0.731 | 11.859 | | | |
| SCR4 | 0.787 | 12.958 | | | |
| SCR5 | 0.831 | 13.853 | | | |
| SCR6 | 0.768 | 12.575 | | | |
| **3. Supply chain disruption orientation** | | | 0.884 | 0.884 | 0.658 |
| SCDO1 | 0.716 | – | | | |
| SCDO2 | 0.739 | 10.974 | | | |
| SCDO3 | 0.897 | 13.180 | | | |
| SCDO4 | 0.877 | 12.944 | | | |
| **4. Supply chain dynamism** | | | 0.781 | 0.795 | 0.568 |
| SCD1 | 0.636 | – | | | |
| SCD2 | 0.886 | 8.701 | | | |
| SCD3 | 0.717 | 8.851 | | | |

Model fit statistics: $\chi^2$ = 413.386; df = 146; $\chi^2$/df = 2.831; RMSEA = 0.087; CFI = 0.923; IFI = 0.924; TLI = 0.910; SRMR = 0.049

the trait-only model are $\chi^2$/df (413.386/146) = 2.831, CFI = 0.923, IFI = 0.924, TLI = 0.910 and RMSEA = 0.087; and $\chi^2$/df (290.384/127) = 2.286, CFI = 0.953, IFI = 0.954, TLI = 0.937 and RMSEA = 0.073 for the trait and method model. The results indicate that the method factor only marginally improved the model fit indices (RMSEA by −0.014, CFI by 0.03, IFI by 0.03, and TLI by 0.027). Also, the path coefficients of the trait factors and their significance were not much different between the two models, indicating that they were robust despite the inclusion of a method factor (Paulraj et al., 2008). Therefore, it can be reasonably concluded that the results were not inflated due to the existence of common method variance in the data.

## 5. Data analysis and results

### 5.1. Reliability, unidimensionality and validity

Relevant analyses to assess the unidimensionality, reliability and validity (discriminant and convergent validity) of theoretical constructs were performed (Fornell and Larcker, 1981; Gerbing and Anderson, 1988; O'Leary-Kelly and Vokurka, 1998). The results are reported in Tables 3 and 4

#### 5.1.1. Reliability and unidimensionality

The two-step method recommended by Narasimhan and Jayaram (1998) was employed in this study to evaluate construct reliability. First, EFA was performed to ensure the unidimensionality of scales, using a principal components analysis with varimax rotation (Hair et al., 2010). Table 3 indicate that the factor analysis generated four factors with eigenvalues greater than one, and all measurement items had strong loadings on the construct that they were intended to measure. Additionally, CFA was used to assess the unidimensionality of scale items (Gerbing and Anderson, 1988). The CFA results reported in Table 4 also show that the measurement model has a good fit (Hair et al., 2010; Hu and Bentler, 1999) which provides a further confirmation of unidimensionality (Gerbing and Anderson, 1988). Therefore, the EFA and CFA results provide strong evidence for unidimensionality of theoretical constructs (Hair et al., 2010). Second, Cronbach's alpha and composite reliability (CR) were used to assess reliability. Table 4 indicates that the Cronbach alpha and CR values of all theoretical constructs were well above the acceptable threshold of 0.70 (Hair et al., 2010). The results therefore provide evidence of reliability.

#### 5.1.2. Validity

As mentioned above, *content validity* was established through a comprehensive review of the literature, critical evaluation of existing theoretical constructs, and a pilot test conducted with academics and industry practitioners.

As shown in Table 4, the measurement model suggests that all indicators in their respective constructs have statistically significant ($p < 0.001$) factor loadings greater than 0.50 and that all t-values were greater than 2, which demonstrate *convergent validity* (Hair et al., 2010; Hu and Bentler, 1999; O'Leary-Kelly and Vokurka, 1998). Additionally, it was found that all of the average variance extracted (AVE) values were greater than the acceptable threshold of 0.50, which provides further evidence of convergent validity (Fornell and Larcker, 1981).

Following the approach recommended by Fornell and Larcker (1981) *discriminant validity* was assessed by comparing the square root of the AVE for each construct with the correlations with all other constructs in the model. As shown in Table 5, the square root of every AVE for each construct is much larger than any correlation among any pair of latent construct, which provides evidence of discriminant validity (Fornell and Larcker, 1981).

### 5.2. Hypothesis test

The proposed research model (see Fig. 1) was tested using structural equation modelling (SEM), and the results are reported in Table 6 and Fig. 2. The structural model has a good fit. The comparative fit index (CFI), incremental fit index (IFI), and Tucker Lewis index (TLI) are greater than or equal to 0.90, the ratio of chi-square and degree of freedom ($\chi^2$/df) is less than 3, the root mean square error of approximation (RMSEA) is below 0.08, and standardized root mean square residual (SRMR) is less than 0.10 (Hair et al., 2010; Hu and Bentler, 1999). Although industry type and firm size were included as control variables in the structural model, these factors (except Industry1, marginally significant, $p = 0.098$) had no significant effect on financial performance. The structural model reveals that supply chain dynamism is positively and significantly related to SCDO (β = 0.284, $p < 0.001$) and SCR (β = 0.111, $p = 0.060$), which lends strong support for H1 and marginal support to H2. The SEM also demonstrates that SCDO has a significant positive effect on SCR (β = 0.698, $p < 0.001$) but no significant direct effect on financial performance (β = 0.133, *n.s.*) and that SCR is positively and significantly associated with financial performance (β = 0.340, $p < 0.001$). Thus, while H3 and H5 are supported, H4 is rejected.

Given the structure of the model tested (Fig. 1) and the hypotheses

**Table 5**
Descriptive statistics.

| | Mean | S.D. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| 1. Financial performance | 4.622 | 1.202 | 0.876[a] | | | |
| 2. Supply chain resilience | 5.004 | 1.034 | 0.425[b] | 0.791 | | |
| 3. Supply chain disruption orientation | 5.458 | 1.106 | 0.362[b] | 0.640[b] | 0.811 | |
| 4. Supply chain dynamism | 4.232 | 1.269 | 0.196[b] | 0.274[b] | 0.241[b] | 0.754 |

Note.
[a] Square root of AVE is on the diagonal.
[b] Correlation is significant at the 0.01 level (2-tailed).

**Table 6**
The results of hypothesis test using SEM.

| Structural paths | Standardized coefficient | t-values | Hypothesis test |
|---|---|---|---|
| Supply chain dynamism → Supply chain disruption orientation | 0.284*** | 3.655 | H1: Supported |
| Supply chain dynamism → Supply chain resilience | 0.111† | 1.880 | H2: Supported |
| Supply chain disruption orientation → Supply chain resilience | 0.698*** | 8.767 | H3: Supported |
| Supply chain disruption orientation → Financial performance | 0.133 | 1.327 | H4: Not supported |
| Supply chain resilience → Financial performance | 0.340*** | 3.327 | H5: Supported |
| **Control variables** | | | |
| Firm size → Financial performance | −0.051 | −0.802 | |
| Industry1 → Financial performance | 0.115† | 1.656 | |
| Industry2 → Financial performance | 0.055 | 0.821 | |
| Industry3 → Financial performance | 0.002 | 0.038 | |
| Industry4 → Financial performance | 0.028 | 0.441 | |
| Model fit statistics: $\chi^2$ = 539.057; df = 232; $\chi^2$/df = 2.324; RMSEA = 0.074; CFI = 0.916; IFI = 0.917; TLI = 0.900; SRMR = 0.053 | | | |

*** $p < 0.001$; † $p < 0.10$.

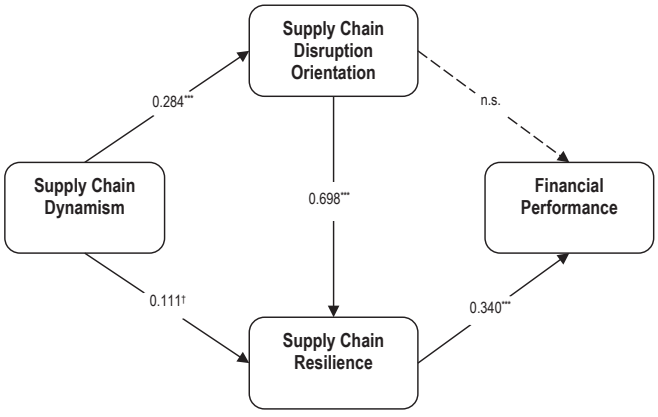


**Fig. 2.** The model estimation results.

proposed (H3-H5), it was logical to investigate the significance of the relationship between SCR, SCDO, and financial performance; specifically, whether SCR acts as a mediator on the relationship between SCDO and financial performance (H6). Therefore, as a follow-on analysis, a bootstrap approach was employed to test for the mediating effect of SCR on the relationship between SCDO and financial performance. Bootstrapping is considered as a more powerful approach than the causal steps approach popularized by Baron and Kenny (1986) for estimating mediation and indirect effects (Preacher, 2015; Preacher and Hayes, 2008; Rungtusanatham et al., 2014). According to the decision tree proposed by Zhao et al. (2010), estimates of direct and indirect effects between independent and dependent variables provide the needed information to understand the presence of a mediation factor. Bias-corrected bootstrapping that generates 10,000 resamples to estimate indirect effects and their significance was used. Table 7 reports the results of the mediation analysis using estimates of direct and indirect paths.

The bootstrap results indicate that the direct effect of SCDO on financial performance was not significant (β = 0.133, *n.s.*). However, the indirect effect of SCDO on financial performance via SCR is positive and significant (β = 0.238, $p < 0.01$; 95% confidence interval: lower bounds = 0.083, upper bounds = 0.416). The results suggest that SCR acts as a mediator on the relationship between SCDO and financial performance. In addition, a Sobel test was conducted (Sobel, 1982) lending additional support for the mediated relationships hypothesized through a change in significance of the indirect effect. As shown in Table 7, the Sobel test indicates that SCR (t = 3.105, $p < 0.01$) fully mediates the relationship between SCDO and financial performance. Thus, H6 is supported.

### 5.3. Accounting for endogeneity

To address the potential endogeneity concerns, following previous studies (e.g. Bellamy et al., 2014; Gligor, 2018; Liu et al., 2016; Wooldridge, 2009) we conducted a two-stage least squares (2SLS) regression analysis with instrumental variables. Table 8 presents the 2SLS results. Before the 2SLS was conducted, we identified firm size and legal protection as two instrumental variables. As shown in Table 6, firm size is not significantly positively related to financial performance. Previous research (e.g. Cai et al., 2010) has suggested that an institutional force such as legal protection is not directly associated with firm performance but significantly related to supply chain practice (e.g. information sharing and collaborative planning with supply chain partners). Thus, firm size and legal protection were considered as variables that meet the instrumental relevance requirement. In the first stage regression, we regressed supply chain initiatives (SCDO and SCR) on all assumed instrumental variables and control variables (Gligor, 2018; Liu et al., 2016). Models 1 and 2 in Table 8 indicate that the $R^2$ of the regressions are 0.307 and 0.470 respectively, significantly higher than the $R^2$ of the regressions with only control variables. The results suggest that firm size and legal protection can be treated as adequate instrumental variables for SCDO and SCR. Following previous studies (Bellamy et al., 2014; Liu et al., 2016), in the second stage we calculated the predicted values of the assumed endogenous variables and used them to test the relationships between supply chain initiatives (SCDO and SCR) and financial performance. As shown by Model 3 in Table 8, the relationship

**Table 7**
Results of bootstrapping and Sobel tests for mediation.

| IV | MV | DV | Effect of IV on MV | Effect of MV on DV | Direct effect | Indirect effect of IV on DV | SE of indirect effect | 95% CI for indirect effect | Sobel test | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| SCDO | SCR | FP | 0.698*** | 0.340** | 0.133 | 0.238** | 0.084 | 0.083–0.416 | t = 3.105** | H6: Full mediation |

Note: SCDO = supply chain disruption orientation; SCR = supply chain resilience; FP = financial performance; IV = independent variable; MV = mediating variable; DV = dependent variable; SE = bootstrap standard error; CI = bootstrap confidence interval.
Standardized effects; 10,000 bootstrap samples.
*** $p < 0.001$; ** $p < 0.01$.

**Table 8**
2SLS model testing for endogeneity.

| | SCDO | SCR | Financial performance |
|---|---|---|---|
| | Model 1 (OLS) | Model 2 (OLS) | Model 3 (2SLS) |
| Industry1 | 0.216*** | 0.048 | 0.080 |
| Industry2 | 0.092 | 0.038 | 0.050 |
| Industry3 | 0.189** | −0.076 | 0.029 |
| Industry4 | 0.146* | 0.038 | 0.034 |
| Firm size[a] | −0.024 | −0.030 | |
| Legal protection[a] | 0.461*** | 0.207*** | |
| Supply chain disruption orientation (SCDO) | | 0.515*** | 0.035 |
| Supply chain resilience (SCR) | | | 0.342*** |
| Supply chain dynamism (SCD) | 0.125* | 0.103* | 0.038 |
| $R^2$ | 0.307 | 0.470 | 0.170 |
| *F-value* | 14.757*** | 25.686*** | 6.799*** |

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.
Note.
[a] Variables used as instruments for the assumed endogenous variable.

between the predicted value of SCR and financial performance is significant and positive. In addition, the 2SLS results are also generally consistent with the SEM results presented in Table 6 and Fig. 2. Hence, we conclude that our results and conclusions were unlikely to be unduly affected by endogeneity. Although we carefully addressed potential endogeneity problems, we recognize that completely eliminating endogeneity is unlikely, which we acknowledge as a limitation of this study.

## 6. Discussion and implications

### 6.1. Theoretical implications

This study provides several original theoretical implications for the interpretation of the relationships among supply chain dynamism, SCDO, SCR, and financial performance. Specifically, the test of the conceptual framework in Fig. 1 provides empirical support for the importance of building resilience capabilities in the presence of elevated levels of supply chain dynamism (Ambulkar et al., 2015; Blackhurst et al., 2011; Juttner and Maklan, 2011; Scholten and Schilder, 2015), thus extending the supply chain management (SCM) literature and bringing a better understanding of the impacts of supply chain dynamism and strategies for mitigating potentially deleterious effects.

The finding of a significant positive effect of supply chain dynamism on both SCDO and SCR leads to new insights into how the external business environment affects supply chain initiatives. In today's turbulent and fast-paced environment, firms need to understand the dynamics and risks inherent within supply chains. The implication is that not properly managed, innovation and new products/processes may not deliver better financial performance. Faced with dynamism in the supply chain, it is important that firms spend time scanning and learning from the environment in order to quickly adapt and respond to changes. The results of this study suggest, consistent with the DCV, that a match between the level of supply chain dynamism and the development of SCDO and SCR is critical. This finding thus extends the work of Zhou and Benton (2007) who demonstrated that supply chain dynamism has significant positive influence on information sharing among supply chain partners.

Confirmation of the significant positive effect of SCDO on SCR is another important contribution of this study. The finding is consistent with that of Ambulkar et al. (2015) and Bode et al. (2011) who noted the importance of SCDO in enhancing SCR and organizational response (i.e. buffering and bridging). Thus, our study reinforces the importance of SCDO in improving the resilience of supply chains. Given that disruptions are increasing in frequency, an SCDO firm is more likely to have greater exposure to disruptions and more experience managing disruptions, and it is thereby more likely to be able to build resilient supply chains that enable the firm to achieve competitive advantages (Ambulkar et al., 2015).

Another core contribution of this study that emerges from the test of the conceptual model is the mediating role of SCR which answers calls for further research into building dynamic capabilities for managing supply chain disruptions (Ambulkar et al., 2015; Blackhurst et al., 2011; Ponomarov and Holcomb, 2009). Specifically, SCR allows firms operating in high dynamism environments to effectively manage risks that can be unforeseen and unquantifiable, recover quickly from disruptions, and improve firm performance (Ponomarov and Holcomb, 2009). One potential explanation is that the firm's orientation toward supply chain disruptions drives its motivation to swiftly and accurately respond to changes in the business environment. Bode et al. (2011) noted that SCDO firms learn from their prior disruption experiences and maintain an awareness of the external business environment allowing them to execute a quick and effective response to reduce the likelihood and impact of future supply chain disruptions. When such responses are appropriate to the context, superior financial performance ensues. As such, revealing a meditating role for SCR has shed new light on the underlying mechanisms affecting financial performance.

The mediation result confirmed in the present study also suggests that simply having a SCDO is important but not sufficient for firms to achieve superior financial performance. Rather, the role that SCR plays is instrumental, which can be seen as a mechanism through which SCDO could be translated into superior financial performance. Thus, the findings of this research suggest that to achieve superior financial performance firms must be able to build SCR capabilities when faced with supply chain dynamism. As such, in highly changing and innovative environments firms that build SCR are more likely to recover from unforeseeable disruptions and events quickly and still obtain high financial performance (Hohenstein et al., 2015; Manuj and Mentzer, 2008).

### 6.2. Managerial implications

#### 6.2.1. Dynamism may be an opportunity not a threat

The findings from this study result in several practical implications. In today's uncertain environment every firm in the supply chain is susceptible to supply chain dynamism. However, being exposed to supply chain dynamism is not necessarily a threat but potentially an opportunity for firms that cultivate a strong SCDO and develop resilient supply chains. Developing robust supply chain initiatives such as SCDO and SCR can provide managers with an effective strategy to deal with risk and recover from supply chain disruptions.

#### 6.2.2. SCR takes precedence over SCDO

The findings also reveal that SCDO and SCR fill different roles in the management of supply chain dynamism. To improve financial performance, firms often choose to either cultivate a SCDO or develop resilient supply chains because limited resources prevent them from pursuing both strategies simultaneously. The finding of the importance of the role of SCR provides guidance for directing efforts and limited resources to use both SCDO and SCR. Specifically, building SCR capabilities should be accorded the highest priority because of the significant direct effect on financial performance and SCR's instrumental role in the relationship between SCDO and financial performance. Nevertheless, the role of SCDO should not be ignored because it precedes SCR. Accordingly, managers can enhance their firm's SCR capability by developing a high SCDO; however, firms cultivating a strong SCDO may only be able to achieve financial benefits through enhancing SCR, suggesting that SCDO and SCR can work together with SCR being

more instrumental to improved financial performance.

In summary, this study provides an integrated conceptual framework that helps mangers better understand the relationships among supply chain dynamism, SCDO, SCR, and financial performance. To survive and prosper a firm should learn from its external environmental conditions and then allocate resources appropriately to various supply chain initiatives, e.g. SCDO or SCR, which enable firms to achieve superior financial performance.

### 6.3. Conclusions and directions for future research

This study contributed to the advancement of both theory and practice in a number of meaningful ways. First, this is the first study to develop and test an integrated theoretical framework examining the relationships among supply chain dynamism, SCDO, SCR, and financial performance. Second, this study demonstrated a significant positive effect of supply chain dynamism on SCDO and SCR which provides insight into how the external business environment influences supply chain initiatives. Third, the first systematic empirical investigation revealing a mediating role for SCR was presented. This study demonstrated that SCR acts as a mediator on the relationship between SCDO and financial performance. Hence this study suggests that SCR is a dynamic capability of the supply chain acting as a mechanism to react to sudden innovation and product introduction. Fourth, the results provided guidelines for managers committing resources to supply chain initiatives in order to achieve superior financial performance at high levels of supply chain dynamism.

While this study contributes to both the literature and business practice, there are several limitations that open up avenues for future research. First, the notion of supply chain dynamism as an opportunity remains a hypothesis. Future studies should focus on market performance, e.g. share gains, as an outcome. Second, this research employed a unified measure of supply chain dynamism. Future studies should look at individual dimensions of dynamism and its corollary uncertainty to determine if different dimensions, e.g. technological, demand, and supply uncertainty, have different impacts on SCR or on either financial or market performance. Third, while interesting and encouraging results are reported in this study, there are a few limitations pertaining to the data collection. Only one industry sector (manufacturing) was surveyed, questionnaire surveys were completed by a single respondent from each firm, and the sample is based in a single economy. Future research may test the proposed theoretical model in other industries in different countries and collect survey data from multiple knowledgeable respondents from each manufacturer, which could increase the generalizability of the results obtained in the study.

## References


Ali, A., Mahfouz, A., Arisha, A., 2017. Analysing supply chain resilience: integrating the constructs in a concept mapping framework via a systematic literature review. Supply Chain Manag.: Int. J. 22 (1), 16–39.

Ambulkar, S., Blackhurst, J., Grawe, S., 2015. Firm's resilience to supply chain disruptions: scale development and empirical examination. J. Oper. Manag. 33–34, 111–122.

Armstrong, J.S., Overton, T.S., 1977. Estimating nonresponse bias in mail surveys. J. Mark. Res. 14 (3), 396–402.

Aslam, H., Blome, C., Roscoe, S., Azhar, T.M., 2018. Dynamic supply chain capabilities: how market sensing, supply chain agility and adaptability affect supply chain ambidexterity. Int. J. Oper. Prod. Manag. 38 (12), 2266–2285.

Barney, J.B., 1991. Firm resources and sustained competitive advantage. J. Manag. 17 (1), 99–121.

Baron, R., Kenny, D., 1986. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J. Personal. Soc. Psychol. 51 (6), 1173–1182.

Bellamy, M.A., Ghosh, S., Hora, M., 2014. The influence of supply network structure on firm innovation. J. Oper. Manag. 32 (6), 357–373.

Benner, M.J., Tushman, M., 2003. Exploitation, exploration, and process management: the productivity dilemma revisited. Acad. Manag. Rev. 28 (2), 238–256.

Bhamra, R., Dani, S., Burnard, K., 2011. Resilience: the concept, a literature review and future directions. Int. J. Prod. Res. 49 (18), 5375–5393.

Bititci, U., Ackermann, F., Ates, A., Davies, J., 2011. Managerial processes: business processes that sustain performance. Int. J. Oper. Prod. Manag. 31 (8), 851–891.

Blackhurst, J., Craighead, C.W., Elkins, D., Handfield, R.B., 2005. An empirically derived agenda of critical research issues for managing supply-chain disruptions. Int. J. Prod. Res. 43 (19), 4067–4081.

Blackhurst, J., Dunn, K.S., Craighead, C., 2011. An empirically derived framework of global supply resiliency. J. Bus. Logist. 32 (4), 374–391.

Bode, C., Wagner, S.M., 2015. Structural drivers of upstream supply chain complexity and the frequency of supply chain disruptions. J. Oper. Manag. 36, 215–228.

Bode, C., Wagner, S.M., Petersen, K.J., Ellram, L.M., 2011. Understanding responses to supply chain disruptions: insights from information processing and resource dependence perspectives. Acad. Manag. J. 54 (4), 833–856.

Brandon-Jones, E., Squire, B., Autry, C.W., Petersen, K.J., 2014. A contingent resource-based perspective of supply chain resilience and robustness. J. Supply Chain Manag. 50, 55–73.

Brusset, X., Teller, C., 2017. Supply chain capabilities, risks, and resilience. Int. J. Prod. Econ. 184, 59–68.

Cai, S., Jun, M., Yang, Z., 2010. Implementing supply chain information integration in China: the role of institutional forces and trust. J. Oper. Manag. 28 (3), 257–268.

Cantor, D.E., Blackhurst, J.V., Cortes, J.D., 2014. The clock is ticking: the role of uncertainty, regulatory focus, and level of risk on supply chain disruption decision making behaviour. Transp. Res. Part E 72, 159–172.

Cao, M., Zhang, Q., 2010. Supply chain collaboration: impact of collaborative advantage and firm performance. J. Oper. Manag. 29 (3), 163–180.

Christopher, M., Lee, H., 2004. Mitigating supply chain risk through improved confidence. Int. J. Phys. Distrib. Logist. Manag. 34 (5), 388–396.

Chavez, R., Jacobs, M., Yu, W., 2017. Data-driven supply chains, manufacturing capability and customer satisfaction. Prod. Plan. Control 28 (11), 906–918.

Christopher, M., Peck, H., 2004. Building the resilient supply chain. Int. J. Logist. Manag. 15 (2), 1–14.

Closs, D.J., Jacobs, M.A., Swink, M., Webb, G.S., 2008. Toward a theory of competencies for the management of product complexity: six case studies. J. Oper. Manag. 26 (5), 590–610.

Craighead, C., Blackhurst, J., Rungtusanatham, J., Handfield, R., 2007. The severity of supply chain disruptions design characteristics and mitigation capabilities. Decis. Sci. J. 38 (1), 131–156.

Dabhilkar, M., Birkie, S.E., Kaulio, M., 2016. Supply-side resilience as practice bundles: a critical incident study. Int. J. Oper. Prod. Manag. 36 (8), 948–970.

Dess, G.G., Beard, D.W., 1984. Dimensions of organizational task environments. Adm. Sci. Q. 29 (1), 52–73.

Downes, L., Nunes, P., 2013. Big-bang disruption. Harv. Bus. Rev. 91 (3), 44–56.

Eisenhardt, K.M., Martin, J.A., 2000. Dynamic capabilities: what are they? Strateg. Manag. J. 21, 1105–1121.

Fisher, M., 1997. What is the right supply chain for your product? Harv. Bus. Rev. 75 (2), 105–116.

Flynn, B.B., Huo, B., Zhao, X., 2010. The impact of supply chain integration on performance: a contingency and configuration approach. J. Oper. Manag. 28 (1), 58–71.

Fornell, C., Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. J. Mark. Res. 18 (1), 29–50.

Fujita, A., 2019. The U.S.-China trade war is disrupting global supply chains in surprising ways. Yahoo Finance, March 28, 2019.

Gerbing, D.W., Anderson, J.C., 1988. An updated paradigm for scale development incorporating unidimensionality and its assessment. J. Mark. Res. 25, 186–192.

Gligor, D., 2018. Performance implications of the fit between suppliers' flexibility and their customers' expected flexibility: a dyadic examination. J. Oper. Manag. 58–59, 73–85.

Golgeci, I., Ponomarov, S.Y., 2013. Does firm innovativeness enable effective responses to supply chain disruptions? An empirical study. Supply Chain Manag.: Int. J. 18 (6), 604–617.

Griffith, E., 2017. The ugly unethical side of Silicon Valley. Fortune Magazine 175 (1), 72–77.

Hair Jr., J.F., Black, W.C., Babin, B.J., Anderson, R.E., Tatham, R.L., 2010. Multivariate Data Analysis, seventh ed. Pearson Education, Upper Saddle River, NJ.

Helfat, C.E., Eisenhardt, K.M., 2004. Inter-temporal economies of scope, organizational modularity, and the dynamics of diversification. Strateg. Manag. J. 25 (13), 1217–1232.

Helfat, C.E., Peteraf, M.A., 2003. The dynamic resource based view: capabilities lifecycles. Strateg. Manag. J. 24 (10), 997–1010.

Hendricks, K.B., Singhal, V.R., 2005. An empirical analysis of the effect of supply chain disruptions on long-run stock price performance and equity risk of the firm. Prod. Oper. Manag. 14 (1), 35–52.

Hohenstein, N.O., Feisel, E., Hartmann, E., Giunipero, L., 2015. Research on the phenomenon of supply chain resilience: a systematic review and paths for further investigation. Int. J. Phys. Distrib. Logist. Manag. 45 (1/2), 90–117.

Hoole, R., 2006. Drive complexity out of your supply chain. Harvard Bus. School Newslett. 3–5 Jan 2006.

Hu, L., Bentler, P.M., 1999. Cut-off criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct. Equ. Model.: Multidiscip. J. 6 (1), 1–55.

Huo, B., Zhao, X., Zhou, H., 2014. The effects of competitive environment on supply chain information sharing and performance: an empirical study in China. Prod. Oper. Manag. 23 (4), 552–569.

Jacobs, M., 2013. Complexity: toward an empirical measure. Technovation 33 (1), 111–118.

Jacobs, M., Swink, M., 2011. Product portfolio architectural complexity and operational performance: incorporating the roles of learning and fixed assets. J. Oper. Manag. 29 (8), 677–691 2011.

Johnson, N., Elliott, D., Drake, P., 2013. Exploring the role of social capital in facilitating supply chain resilience. Supply Chain Manag.: Int. J. 18 (3), 324–336.
Juttner, U., Maklan, S., 2011. Supply chain resilience in the global financial crisis: an empirical study. Supply Chain Manag.: Int. J. 16 (4), 246–259.
Kamalahmadi, M., Parast, M.M., 2016. A review of the literature on the principles of enterprise and supply chain resilience: major findings and directions for future research. Int. J. Prod. Econ. 171, 116–133.
Lawrence, P., Lorsch, J., 1967. Organization and Environment: Managing Differentiation and Integration. Division of Research, Graduate School of Business Administration, Harvard University, Boston.
Lee, H.Y., Seo, Y.J., Dinwoodie, J., 2016. Supply chain integration and logistics performance: the role of supply chain dynamism. Int. J. Logist. Manag. 27 (3), 668–685.
Lengnick-Hall, C., Beck, E., 2005. Adaptive fit versus robust transformation: how organizations respond to environmental change. J. Manag. 31 (5), 738–757.
Li, Y., Li, P.P., Liu, Y., Yang, D., 2010. Learning trajectory in offshore OEM cooperation: transaction value for local suppliers in the emerging economies. J. Oper. Manag. 28, 269–282.
Liu, H., Wei, S., Ke, W., Wei, K., Hua, Z., 2016. The configuration between supply chain integration and information technology competency: a resource orchestration perspective. J. Oper. Manag. 44, 13–29.
Manuj, I., Mentzer, J.T., 2008. Global supply chain risk management strategies. Int. J. Phys. Distrib. Logist. Manag. 38 (3), 192–223.
Miller, D., Friesen, P.H., 1983. Strategy-making and environment: the third link. Strateg. Manag. J. 4 (3), 221–235.
Narasimhan, R., Jayaram, J., 1998. Causal linkage in supply chain management: an exploration study of North American manufacturing companies. Decis. Sci. J. 29 (3), 579–605.
Narasimhan, R., Kim, S.W., 2002. Effect of supply chain integration on the relationship between diversification and performance: evidence from Japanese and Korean firms. J. Oper. Manag. 20 (3), 303–323.
O'Leary-Kelly, S.W.O., Vokurka, R.J., 1998. The empirical assessment of construct validity. J. Oper. Manag. 16 (4), 387–405.
Park, K., Min, H., Min, S., 2016. Inter-relationship among risk taking propensity, supply chain security practices, and supply chain disruption occurrence. J. Purch. Supply Manag. 22, 120–130.
Paulraj, A., Lado, A., Chen, J., 2008. Inter-organizational communication as a relational competency: antecedents and performance outcomes in collaborative buyer–supplier relationships. J. Oper. Manag. 26 (1), 45–64.
Pereira, C.R., Christopher, M., Silva, A.L.D., 2014. Achieving supply chain resilience: the role of procurement. Supply Chain Manag.: Int. J. 19 (5/6), 626–642.
Pettit, T.J., Croxton, K.L., Fiksel, J., 2013. Ensuring supply chain resilience: development and implementation of an assessment tool. J. Bus. Logist. 34 (1), 46–76.
Podsakoff, P.M., MacKenzie, S., Lee, J., Podsakoff, N., 2003. Common method biases in behavioral research: a critical review of the literature and recommended remedies. J. Appl. Psychol. 88 (5), 879–903.
Ponomarov, S.Y., Holcomb, M.C., 2009. Understanding the concept of supply chain resilience. Int. J. Logist. Manag. 20 (1), 124–143.
Powell, B., 2011. When supply chains break. Fortune Magazine 164 (10), 29–32.
Preacher, K.J., 2015. Advances in mediation analysis: a survey and synthesis of new developments. Annu. Rev. Psychol. 66, 825–852.
Preacher, K.J., Hayes, A.F., 2008. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behav. Res. Methods 40 (3), 879–891.
Purvis, L., Spall, S., Naim, M., Spiegler, V., 2016. Developing a resilient supply chain strategy during 'boom' and 'bust'. Prod. Plan. Control 27 (7–8), 579–590.
Revilla, E., Saenz, M.J., 2017. The impact of risk management on the frequency of supply chain disruptions: a configurational approach. Int. J. Oper. Prod. Manag. 37 (5), 557–576.
Rungtusanatham, M., Miller, J., Boyer, K., 2014. Theorizing, testing, and concluding for mediation in SCM research: tutorial and procedural recommendations. J. Oper. Manag. 32 (3), 99–113.
Scholten, K., Schilder, S., 2015. The role of collaboration in supply chain resilience. Supply Chain Manag.: Int. J. 20 (4), 471–484.
Scholten, K., Scott, P.S., Fynes, B., 2014. Mitigation processes – antecedents for building supply chain resilience. Supply Chain Manag.: Int. J. 19 (2), 211–228.
Sheffi, Y., Rice, J.B., 2005. A supply chain view of the resilient enterprise. MIT Sloan Manag. Rev. 47 (1), 41–48.
Skipper, J.B., Hanna, J.B., 2009. Minimizing supply chain disruption risk through enhanced flexibility. Int. J. Phys. Distrib. Logist. Manag. 39 (5), 404–427.
Sobel, M.E., 1982. Asymptotic intervals for indirect effects in structural equations models. In: Leinhart, S. (Ed.), Sociological Methodology. Jossey-Bass, San Francisco, pp. 290–312.
Sodhi, M.S., Son, B.G., Tang, C.S., 2012. Researchers' perspectives on supply chain risk management. Prod. Oper. Manag. 21 (1), 1–13.
Stevenson, M., Busby, J., 2015. An exploratory analysis of counterfeiting strategies: towards counterfeit-resilient supply chains. Int. J. Oper. Prod. Manag. 35 (1), 110–144.
Teece, D.J., 2007. Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. Strateg. Manag. J. 28 (13), 1319–1350.
Teece, D.J., Pisano, G., Shuen, A., 1997. Dynamic capabilities and strategic management. Strateg. Manag. J. 18 (7), 509–533.
Tukamuhabwa, R.B., Stevenson, M., Busby, J., Zorzini, M., 2015. Supply chain resilience: definition, review and theoretical foundations for further study. Int. J. Prod. Res. 53 (18), 5592–5623.
Vickery, S.K., Jayaram, J., Droge, C., Calantone, R., 2003. The effects of an integrative supply chain strategy on customer service and financial performance: an analysis of direct versus indirect relationships. J. Oper. Manag. 21, 523–539.
Williams, L.J., Cote, J.A., Buckley, M.R., 1989. Lack of method variance in self-reported affect and perceptions at work: reality or artifact. J. Appl. Psychol. 74, 462–468.
Witcher, B., Chau, V., Harding, P., 2008. Dynamic capabilities: top executive audits and hoshin kanri at Nissan South Africa. Int. J. Oper. Prod. Manag. 28 (6), 540–561.
Wooldridge, J.M., 2009. Econometric Analysis of Cross Section and Panel Data. MIT Press, Cambridge, MA.
Wu, T., Blackhurst, J., O'grady, P., 2007. Methodology for supply chain disruption analysis. Int. J. Prod. Res. 45 (7), 1665–1682.
Yu, W., Jacobs, M.A., Salisbury, W.D., Enns, H., 2013. The effects of supply chain integration on customer satisfaction and financial performance: an organizational learning perspective. Int. J. Prod. Econ. 146 (1), 346–358.
Zhao, X., Flynn, B.B., Roth, A.V., 2006. Decision sciences research in China: a critical review and research agenda–foundations and overview. Decis. Sci. J. 37 (4), 451–496.
Zhao, X., Lynch, J.G., Chen, Q., 2010. Reconsidering Baron and Kenny: myths and truths about mediation analysis. J. Consum. Res. 37 (2), 197–206.
Zhou, H., Benton, W.C., 2007. Supply chain practice and information sharing. J. Oper. Manag. 25 (6), 1348–1365.
Zollo, M., Winter, S.G., 2002. Deliberate learning and the evolution of dynamic capabilities. Organ. Sci. 13 (3), 339–351.