Building supply-side resilience – a behavioural view

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Abstract

Purpose – To build resilient supply chains, buyers should implement risk mitigation tactics. The purpose of this paper is to provide insights into the risky decision-making process that underlies buyers’ decisions to adopt supply risk mitigation tactics for creating supply-side resilience.

Design/methodology/approach – The authors employ experimental scenarios to simulate supply disruptions of low and high likelihood. The authors then assess buyers’ decisions to adopt supply risk mitigation tactics in response to these scenarios.

Findings – The authors find that buyers’ perceptions of supply disruption likelihood are positively related to their adoption of buffer- and process-oriented risk mitigation tactics and preference for process-oriented risk mitigation tactics. Conversely, risk propensity negatively affects buyers’ adoption of buffer- and process-oriented mitigation tactics.

Originality/value – Beyond risk perceptions, the authors consider how risk propensity also affects the risky decision-making process. Moreover, whereas previous studies often focus on a single mitigation tactic, the authors study buyers’ adoption of multiple buffer- and process-oriented risk mitigation tactics to create supply-side resilience.

Keywords Supply risk, Risk propensity, Multilevel model, Risk mitigation, Supply-side resilience

Paper type Research paper

1. Introduction

Supply chain disruptions, and their mitigation, represent a pressing concern for today’s purchasing and supply managers (i.e. “buyers”). In fact, the average firm copes with roughly 14 supply chain disruptions each year (Bode and Wagner, 2015). Research also shows that these disruptions can be costly. While supply chain disruptions decrease firms’ stock prices by 10 per cent, on average (Hendricks and Singhal, 2005), the most severe disruptions reduce firm share price by 30 per cent and take years to recover (Wildgoose et al., 2012). Recent well-known examples of such supply chain disruptions include the tsunami in Japan, which caused disruptions in the production of cars at Toyota and resulted in a 25 per cent decrease in worldwide production for five months (Tomlin, 2014), and the months-long flooding in Thailand, which led to losses of $1bn in sales for Intel because of its inability to source hard drives.

While some firms experience severe losses, other firms are better able to withstand supply chain disruptions. For example, during the Japanese tsunami, Nissan quickly sourced direct materials with alternate suppliers to resume operations and recover “lost market share more quickly than Toyota” (Melnyk et al., 2015). Similarly, through initial investments in robust resources, continuous external monitoring and quick reactions to facilitate recovery, General Motors’ Thailand operations were able to stem losses during the 2011 Thailand floods (Melnyk et al., 2015). Christopher and Peck (2004) attribute such performance in the face of disruptions to supply chain resilience – an adaptive capability that prepares the supply chain for unexpected events and enables it to respond to disruptions and to recover faster (Ponomarov and Holcomb, 2009).
Recent research more narrowly focuses on upstream resilience capabilities, showing that supply-side resilience positively affects operational performance (Dabhilkar et al., 2016). The normative view of supply-side resilience intimates that buyers should align investment in mitigation capabilities with the supply risks that they face to improve performance (Blackhurst et al., 2011; Pettit et al., 2010). Extant research suggests two overarching approaches for supply risk mitigation – i.e., buffer- and process-oriented mitigation strategies (Zsidisin and Ellram, 2003). The buffer-oriented mitigation strategy is comprised of tactics that generally rely on investments in redundant resources, such as inventories and suppliers, to protect the firm from the detrimental effects of disruptions. Such tactics enable a firm to continue its operational activities despite a disruption (Brandon-Jones et al., 2014). Alternately, the process-oriented mitigation strategy consists of relational tactics with the goal of improving supplier and/or process performance and creating visibility in the supply chain. These relational tactics increase supply chain flexibility enabling a quicker, more efficient return to normal operating performance after a disruption (Bode et al., 2011; Zsidisin and Ellram, 2003).

Despite their performance implications, prior research provides little insight into the complex decisions to adopt buffer- and/or process-oriented mitigation tactics to build supply-side resilience. Therefore, we apply risky decision-making theory to advance a model of supply-side resilience to address this gap. The focal dependent variable of risky decision-making theory is risk behaviour (Sitkin and Pablo, 1992), which we conceptualize as the adoption of and preference for buffer- and process-oriented mitigation tactics. The theory advances two predictors of risk behaviour: risk perception – i.e., the judgement of the potential loss inherent in a situation and risk propensity – i.e., the predisposition to adopt more risky behaviour (Sitkin and Pablo, 1992). Adopting the buyer as our unit of observation, our application of risky decision-making theory to the study of supply-side resilience motivates the following research question:

**RQ1.** How do buyers’ risk perceptions and risk propensity affect their adoption of and preference for buffer- and process-oriented mitigation tactics?

Our empirical investigation of this research question, which is based on the analysis of primary response data from 113 buyers who adopt specific mitigation tactics in response to risky situations described in two experimental scenarios, has several salient theoretical implications. Notably, our study integrates two largely dissociated streams of literature separately focused on risky decision-making and resilience. This integration enables a new application domain for risky decision-making theory: whilst traditional decision-making studies examine the selection of a single alternative from a set that varies in terms of uncertainties and gains (e.g. Kahneman and Tversky, 1979), our application explicitly considers buyers’ decisions aimed at minimizing losses through the potential adoption of multiple mitigation tactics. Similarly, in contrast to traditional studies of resilience, which tend to focus on a singular mitigation tactic (Ellis et al., 2010) or view individual tactics as alternatives in response to a disruption (Talluri et al., 2013), our study examines buyers’ simultaneous adoption of potentially multiple tactics culled from buffer- and process-oriented mitigation strategies. Moreover, our integrated approach motivates the consideration of key behavioural variables – i.e., likelihood of supply disruption and risk propensity (Sitkin and Pablo, 1992) – as determinants of buyers’ risk-mitigating behaviours. Our results provide new insights into the factors that affect how buyers build supply-side resilience.

2. Literature review
A growing body of literature demonstrates the positive effects of resilience finding that agility and robustness (Wieland and Wallenburg, 2013), flexibility and agility (Gunessee et al., 2018),
response capabilities (Su and Linderman, 2016), and proactive and reactive supply mitigation strategies (Dabhilkar et al., 2016) positively affect operational, firm and supply chain performance. Inherent in these studies is the essential notion that supply chain resilience is underpinned by adaptive capability (Ponomarov and Holcomb, 2009) – i.e., a supply chain’s “latent ability to develop different responses to match the nature of the threats it faces” (Tukamuhabwa et al., 2015, p. 5599). Consistent with this logic, Pettit et al. (2010) explicitly recognize resilience as a balance between vulnerabilities and capabilities. Central to Pettit et al.’s (2010) conceptualization is that supply chain vulnerabilities result from external changes and firms should adopt sets of mitigation capabilities which are best able to overcome realized vulnerabilities and achieve “balanced resilience”; in so doing, firms may align investment and risk. As Pettit et al. (2010) argue, the issue of balance is essential to firm performance: whereas vulnerabilities in the excess of capabilities unduly expose the firm to financial losses, excessive investment in capabilities also erodes firm profitability.

Extending resilience-as-balance logic, Gunasekaran et al. (2015) hold that resilient supply chains maintain sufficient capabilities that reduce exposure to a wide range of potential disruptions; accordingly, their study advances a supply chain capability management framework in which resilience is premised on understanding global sourcing complexities and adopting supply management approaches to overcome these complexities. Whereas several case (e.g. Scholten et al., 2014) and survey-based studies (e.g. Brusset and Teller, 2017) advance a similar perspective, Talluri et al. (2013) develop an empirically grounded supply chain simulation to assess the relative efficiencies of risk mitigation tactics for situations with varying risk profiles; their simulation results support the resilience-as-balance perspective by showing that particular mitigation tactics are optimal for select risk profiles.

Whilst the resilience-as-balance view is often applied at the supply chain level, several studies (e.g. Blackhurst et al., 2011; Dabhilkar et al., 2016; Gunasekaran et al., 2015) more narrowly focus on supply-side resilience – i.e., adaptive capabilities or practices that enable firms to react to or withstand upstream vulnerabilities. These studies conceptualize vulnerabilities as supply disruptions, which refer to unforeseen events that interfere with the normal flows of goods and/or materials between firms (Craighead et al., 2007, p. 132) and reflect undesirable events ranging from extreme weather to operational obstacles (Wagner and Bode, 2008; Bode and Wagner, 2015). Generally, supply disruptions may be classified according to their probability and consequences (Sheffi and Rice, 2005). Infrequent disruptions that interrupt supply for long durations and recurrent disruptions having a limited impact are among the two most studied disruption categories in the literature. For example, Tomlin (2006) recognizes these types of disruptions by categorizing long-but-rare disruptions and short-but-frequent disruptions in planning mitigation strategies. Building on these categorizations, Tang (2006) advances a typology that classifies supply disruptions as global or operational. Global disruptions refer to major, high-impact disruptions that occur with low frequency (Tang, 2006) and include natural disasters (e.g. tsunamis, earthquakes, hurricanes and disease outbreak) as well as economic crises (e.g. excessive public debt, banking system failures and exchange controls) and social unrest (e.g. terrorism and worker strikes) (Ellis et al., 2011). These disruptions occur when the supply chain is unexpectedly and radically upset through unavailability or failure of resources or capabilities (Talluri et al., 2013). In contrast, operational disruptions occur more frequently, have a less severe impact (Tang, 2006) and generally reflect a supplier’s temporary inability to deliver high-quality inputs in a timely manner (Manuj and Mentzer, 2008). Moreover, operational disruptions reflect delays and distortions that can occur when supply chain system parameters, such as lead time or order quantity, stray from their expected value (Talluri et al., 2013).

According to the resilience-as-balance view, the threat of supply disruptions motivates buyers to create resilient supply chains by adopting supply risk mitigation tactics – i.e.,
actions to decrease the likelihood and/or negative consequences of a supply disruption (Kim et al., 2015). While firms may proactively invest in mitigation capabilities, they more often increase their resilience by selecting new mitigation tactics after experiencing a disruption. As Bode et al. (2011) suggest, risk mitigation decisions are shaped from past experiences and evolve as a response to a disruption. This disruption-response sequence is governed by two intertwined mechanisms: the pursuit of stability and the extra resources required to create this stability (Bode et al., 2011). Each time a disruption happens, managers must consider new mitigation tactics to cope with an ever-changing environment and bolster supply chain resilience.

While extant literature identifies many types of mitigation tactics, Zsidisin and Ellram (2003) assert that supply risk mitigation tactics can be classified into buffer- and process-oriented strategies. The buffer-oriented strategy attenuates negative effects by establishing safeguards that protect a firm from disruptions in the supply of goods. Tactics that comprise the buffer-oriented strategy largely rely on excess or redundant resources (Sheffi, 2005). While effective in curbing the magnitude of supply loss, the buffer-oriented strategy does little to reduce the likelihood of disruption and increases inefficiencies (Wagner and Bode, 2008; Talluri et al., 2013). Additionally, increasing product variety and decreasing product cycle times can lead to a significant rise in costs of tied-up capital and obsolescence when buffer-oriented risk mitigation tactics are used (Tang, 2006). The buffer-oriented strategy includes mitigation tactics such as holding safety stock, sourcing from multiple suppliers and/or asking suppliers to hold extra inventory (Zsidisin and Ellram, 2003).

The process-oriented strategy mitigates uncertainty by facilitating “boundary-spanning” and “boundary-shifting” actions with a supplier (Bode et al., 2011). Firms can improve their ability to detect potential disruptions through activities such as auditing, monitoring and certifying suppliers. For example, regularly evaluating the financial viability of suppliers may help buyers avoid the negative consequences of supplier default, insolvency or bankruptcy (Milne, 2009). Also, closer buyer–supplier relationships create additional mechanisms for sensing what is happening at the supplier, providing advanced notice and enabling a faster reaction to disruption (Chen et al., 2013). For instance, supplier certification and supplier development activities increase buyer–supplier interaction, leading to extra opportunities to learn, exchange information and informally monitor suppliers’ behaviours. Moreover, these process-oriented tactics reduce the likelihood of disruption through buyers’ intentional efforts to improve suppliers’ performance and capabilities (Celly and Frazier, 1996; Talluri et al., 2013). In addition, as Eisenhardt (1989) suggests, these process-oriented approaches reduce the risks of moral hazard (i.e. lack of supplier effort) and adverse selection (i.e. inaccurate assessment of supplier capabilities).

The attributes of buffer- and process-oriented mitigation strategies suggest that the decision to adopt a particular strategy is complex. Focusing solely on a buffer-oriented mitigation strategy can have detrimental effects on a firm’s profitability due to the capital devoted to inventories and increased transaction costs associated with managing multiple suppliers for the same purchases (Zsidisin and Ellram, 2003; Talluri et al., 2013). Yet, a process-oriented mitigation strategy may not always provide the intended results and it requires substantial buyer investment in relationship-building mechanisms, which is often not possible for all supplier relationships. Accordingly, neither of these mitigation strategies is universally superior. Adding further complexity, buyers’ risk mitigation decisions are subject to time and other resource constraints.

Our review of the resilience literature highlights four salient findings: resilience is important – it positively affects performance-based outcomes (e.g. Wieland and Wallenburg, 2013); resilience requires the effective balancing of vulnerabilities and mitigation capabilities (Pettit et al., 2010); individual mitigation tactics are more or less efficient at
building resilience (Talluri et al., 2013); and selecting one or more buffer- or process-oriented mitigation tactics to build resilience can be difficult (Bode et al., 2011). Given these findings, it is surprising that there is little research that examines how managers actually make complex decisions to build resilience. The risky decision-making literature has long asserted the importance of studying what managers do; specifically, this line of research enables analyses of the deviation between what managers should and actually do, helps managers understand how to make better decisions and facilitates the development of risk-taking (or risk-mitigating) policies that align managerial behaviours with firms’ goals (Das and Teng, 2001; Slovic and Lichtenstein, 1971). Accordingly, we apply risky decision-making theory to the study of supply-side resilience.

Risky decision-making theory advances a process view of the cognitive decision-making process (Yates and Stone, 1992) and focuses on the prediction of “an individual decision-maker’s behavioural responses” to situations characterized by varying levels of risk (Sitkin and Pablo, 1992, p. 25). As summarized by Sitkin and Pablo (1992), the central assertion of this theory is that risk behaviour – i.e., an individual’s selection of a particular behaviour from many risky alternatives – is determined by two factors: risk perception and risk propensity. Risk perception refers to individuals’ estimates of the risk – i.e., the down-side possibilities or potential loss – inherent in a situation (Das and Teng, 2001). To determine loss, individuals assess projected outcomes associated with alternate behaviours relative to a target outcome – i.e., “an outcome a person actively works to obtain” (Yates and Stone, 1992, p. 8). Risky decision-making theory predicts that individuals prefer and subsequently adopt behaviours having projected outcomes that maximize gains or minimize losses relative to their target outcome (Lopes, 1987). Alternately, risk propensity is an individual attribute characterizing the cumulative general “tendency to take and avoid risk” (Pablo et al., 1996; Sitkin and Weingart, 1995, p. 1575). In accordance with risky decision-making theory, it predisposes individuals to accept certain risks and adopt riskier behaviours than others (Bromiley and Curley, 1992). Importantly, these basic precepts of risky decision-making theory suggest it is particularly well-aligned with the resilience-as-balance view: the complexities and consequences of adopting mitigation tactics qualify this choice as a risky decision (Bode et al., 2011); analogous to gambles with differing payoffs (Kahneman and Tversky, 1979), mitigation tactics have varying efficiencies (Talluri et al., 2013); and both risky decision-making theory and the resilience-as-balance view highlight the formative role of risk perception in determining behaviour (Pettit et al., 2010).

3. Model development
To facilitate our conceptual development, we adopt the purchase of a particular direct material from a specific supplier as the context of our study. We apply risky decision-making theory to advance a model which examines situational and dispositional factors that affect buyers’ decisions to adopt mitigation tactics to build supply-side resilience. The focal dependent variable of our conceptual model is risk behaviour which we operationalize as buyers’ adoption of both buffer- and/or process-oriented mitigation tactics and buyers’ preference of buffer- vs process-oriented mitigation tactics. Whereas the former operationalization enables insights into buyers’ overall mitigation behaviours to build “balanced” supply-side resilience, the latter facilitates a test of the fundamental question posed within the risky decision-making literature: given a set of potential behaviours that vary in terms of inherent risk, which alternative (i.e. mitigation strategy) do individuals (i.e. buyers) prefer to create supply-side resilience? Consistent with risky decision-making theory, we hypothesize that buyer’s risk behaviour is influenced by buyers’ risk perceptions, operationalized as the likelihood of supply disruption, and buyers’ risk propensity.
3.1 Risk perception

Risk perceptions are formed when an individual constructs a personal characterization of a situation and it is this characterization that drives an individual’s actions (Yates and Stone, 1992). Drawing from Yates and Stone (1992), Ellis et al. (2010) examine buyer behaviour and suggest that the effect of the situation on individual action is mediated by three risk perceptions: the likelihood of supply disruption, the magnitude of supply disruption and overall supply risk. Whereas likelihood of supply disruption refers to the probability that a given event will disrupt the flow of supplies, magnitude of supply disruption reflects the potential impact that the given event will have on performance (Sheffi and Rice, 2005). Ellis et al. (2010) find empirical support for a cognitive process in which buyers’ judgments of the likelihood and magnitude of supply disruptions are aggregated to form overall evaluations of supply disruption risk, which, in turn, drive buyers’ mitigation behaviour. Importantly, similar to Kahneman and Tversky (1979), they conclude that buyers’ perceptions of the likelihood of supply disruption have twice the effect on their mitigation behaviour as compared to their perceptions of the magnitude of supply disruption. Hence, similar to the approach of Talluri et al. (2013), we adopt the likelihood of supply disruption as the focal risk perception considered within our study.

Risky decision-making theory advances conceptual argumentation that links buyers’ perceptions of the likelihood of supply disruption with their adoption of mitigation tactics. Yates and Stone (1992) assert that, ceteris paribus, individuals will select alternatives that minimize loss. Ellis et al. (2010) apply this logic and find that buyers who perceive high levels of supply disruption risk develop alternate suppliers to mitigate such risk. Consistent with the premise of “balanced” supply-side resilience, these studies suggest that vulnerabilities drive the adoption of mitigation tactics. More broadly, we suggest that, motivated by their innate desire to minimize loss when faced with a threat, buyers’ perceptions of the likelihood of supply disruption drive their increased adoption of mitigation tactics:

\[ H1a. \] The likelihood of supply disruption is positively related to the adoption of mitigation tactics.

We assert that buyers prefer buffer-oriented mitigation tactics when supply disruptions are unlikely and process-oriented mitigation tactics for situations in which the likelihood of supply disruption is high. Three explanatory mechanisms account for this relationship: the level of equivocality inherent in a risky situation, the certainty with which the strategy will mitigate the risk and the ease of implementing the mitigation strategy. Equivocality reflects the extent to which “multiple meanings are linked to a particular situation” rendering “the relative superiority of a particular meaning […] ambiguous” (Ellis et al., 2011, p. 82). As Bode et al. (2011) intimate, infrequent disruptions provide little opportunity for learning; as such, buyers neither accrue knowledge of nor experiences with the causes, conditions and consequences of infrequent disruptions. Lacking sufficient knowledge, buyers face difficulties in determining adequate responses leading to the application of simple rules of thumb (Bode et al., 2011). This motivates buyers’ adoption of buffer-oriented mitigation tactics, like holding inventory and maintaining multiple suppliers, to mitigate risk. Notably, these approaches provide a given level of certainty, are relatively easy to implement and require little information about the disruption to be effective (Zsidisin and Ellram, 2003). For example, inventory can mitigate a disruption in accordance with the number of days of stock on-hand. Similarly, purchases can be immediately diverted to an alternate supplier that is at-the-ready. Moreover, even when knowledge of the type or source of the supply disruption is limited, buffer-oriented tactics can be effective with little inter-organizational coordination or effort. Hence, a buffer-oriented mitigation strategy is particularly suitable for low-likelihood supply disruptions, where learning is impaired by the
infrequency of the disruption. Alternately, more frequent supply disruptions create buyers’ awareness, sensitize buyers and help to resolve buyers’ equivocality by enabling buyers’ enhanced understanding of sources and types of disruptions through repeated experiences (Bode et al., 2011). This enhanced understanding enables the use of process-oriented mitigation tactics, like supplier development and certification that generally require higher levels of product and process knowledge to be effective (Chen et al., 2015). Moreover, the prospect of frequent supply disruptions motivates buyers’ commitment to resolve the underlying cause of supply discontinuities to prevent disruptions from recurring (Choi and Hartley, 1996). Such commitment is necessary to support the increased investment in inter-organizational coordination and problem-solving efforts required for the implementation of process-oriented mitigation tactics (Krause, 1999). Hence, in line with the notion of “balanced resilience”, supply disruptions characterized by higher likelihood motivate buyers’ use of a process-oriented mitigation strategy to create supply-side resilience:

*H1b.* The likelihood of supply disruption is negatively related to the preference for buffer-oriented mitigation tactics.

### 3.2 Risk propensity

As a personality trait, risk propensity reflects an individual’s general predisposition towards risk-taking behaviour, which ranges from risk-averse to risk-seeking (Sitkin and Weingart, 1995). Given a set of payoff alternatives of equal expected value, risk-aversion is associated with uncertainty avoidance and the preference for payoffs characterized by higher likelihood but lower magnitude. In contrast, when presented with the same alternatives, risk-seeking individuals tolerate greater uncertainty; that is, they embrace a low likelihood of payoff in the pursuit of higher payoffs (Kahneman and Tversky, 1979). Similarly, risk-seeking individuals tend to more heavily weigh data associated with opportunity as compared to loss when making decisions; the opposite is true for those who are risk-averse (Sitkin and Pablo, 1992; Sitkin and Weingart, 1995).

Consistent with risky decision-making theory, we posit that buyers’ risk propensity affects their adoption of risk mitigation tactics as a result of two causal mechanisms: uncertainty tolerance and information filtering. In particular, we assert that risk-averse buyers, who are conservative in nature, have little tolerance for losses stemming from supply disruptions and therefore increasingly invest in tactics to mitigate such risks. Moreover, risk-averse buyers filter information to emphasize potential losses stemming from supply disruptions; this further motivates risk-averse buyers’ adoption of risk mitigation tactics. In contrast, risk-seeking buyers, who embrace uncertainty and tend to emphasize the magnitude of potential gains, are less likely to adopt mitigation tactics:

*H2a.* Risk propensity is negatively related to the adoption of mitigation tactics.

We posit that risk-averse buyers prefer buffer-oriented mitigation tactics and, alternately, risk-seeking buyers opt for process-oriented mitigation tactics. We advance two explanatory mechanisms to support our assertion: the level of certainty that the employed strategy will mitigate the supply disruption and the ancillary relational benefits that can also be obtained through the adoption of the mitigation strategy. Buffer-oriented mitigation tactics, such as holding inventory, “provide an additional measure of protection from risk”, suggesting with increased certainty that such tactics will effectively mitigate risk (Zsidisin and Ellram, 2003, p. 18). While successful implementation requires relatively little buyer effort, buffer-oriented strategies do not yield ancillary relational benefits. In fact, in the absence of disruptions, these tactics increase costs but lack utility (Sheffi and Rice, 2005). Despite these drawbacks, risk-averse buyers adopt buffer-oriented mitigation tactics to assure greater certainty of supply thereby employing a more defensive approach to
restore stability and protect their operations. Alternately, process-oriented mitigation tactics offer several ancillary relational benefits: sole sourcing allows buyers to aggregate volumes with key suppliers and access benefits, such as advanced supplier innovations, that are reserved for customers of choice (Ellis et al., 2011); supplier development enables closer supplier relationships and enhanced supplier and buyer performance (Chen et al., 2016); and supplier certification programs increase product quality while reducing product costs (Larson and Kulchitsky, 1998). However, successful implementation of process-oriented mitigation tactics cannot be assured as it requires intensive inter-organizational efforts that are difficult to coordinate and that are time-consuming (Choi and Hartley, 1996). Moreover, successful implementation is conditioned not only upon buyers’ efforts but also suppliers’ behavioural compliance. Accordingly, risk-seeking buyers, who are predisposed to willingly risk more uncertain outcomes to maximize potential gains (Kahneman and Tversky, 1979), are well-suited to cope with the relational uncertainties associated with the adoption of process-oriented tactics (Heide, 1994; Zsidisin and Ellram, 2003):

H2b. Risk propensity is negatively related to the preference for buffer-oriented mitigation tactics.

3.3 Control variables
Drawing from risky decision-making theory, our hypotheses suggest that risk perception and risk propensity represent primary behavioural factors that motivate buyers’ adoption of and preference for risk mitigation tactics. Yet, extant literature suggests that firm- and dyadic-level variables also influence buyers’ decisions to implement such mitigation tactics. Therefore, we control for firm size, geographic location and cross-country exchange. The link between firm size and the adoption of risk mitigation tactics is supported by a practical consideration: mitigation tactics require organizational resources. For example, buffer-oriented risk mitigation tactics require investments in redundant resources before disruptions occur and, in the absence of disruption, often go unused (Tomlin, 2006). This suggests that the use of buffer-oriented risk mitigation tactics requires sufficient financial resources. Moreover, process-oriented mitigation tactics are also human resource-intensive (Kleindorfer and Saad, 2005). Specifically, process-oriented tactics rely on the development of collaborative supplier relationships, which involve intensive interaction between buyers and suppliers over time (Heide, 1994; Zsidisin and Ellram, 2003). Hence, large firms are better positioned to enact both buffer- and process-oriented risk mitigation tactics.

Geographic location affects the specific regulations, environments and cultural values that impose standards for the mitigation of risk (Jannings and Zandbergen, 1995; Tang and Zimmerman, 2013). Accordingly, Jackson and Apostolakou (2010) assert that firms in Western European countries with strong institutionalized stakeholder involvement and performance pressures are more likely to achieve higher levels of performance in the economic dimension of corporate social responsibility, which includes risk and crisis management. By extension, we suggest that buyers in western countries, which have stakeholders with demanding requirements for delivery and quality performance as well as mature risk management systems, maintain a strong risk orientation and are more likely to adopt a comprehensive approach to risk mitigation. Moreover, firms with mature risk management approaches are likely to possess the requisite knowledge and skills to implement process-oriented mitigation tactics. In contrast, non-western firms with less mature risk management capabilities likely adopt buffer-oriented mitigation tactics, such as holding inventory, due to the ease of implementation (Tomlin, 2006).

Cross-country exchange involves complex international supply chains and cross-cultural collaborations; these factors complicate risk mitigation efforts (Manuj and Mentzer, 2008). In cross-country exchange, firms cope with a greater number of unknowns and, with
diminished visibility, disruptions are more difficult to detect. One way to cope with these uncertainties is to implement process-oriented mitigation tactics, such as supplier development and supplier certification practices. However, differences in language and culture associated with cross-country exchange render these process-oriented mitigation tactics, which typically require inter-firm collaboration (Zsidisin and Ellram, 2003), more difficult to effectively implement. These circumstances suggest that buffer-oriented tactics are particularly useful in mitigating disruptions when exchange spans countries’ borders.

4. Methodology
4.1 Research design
To test our hypotheses, we developed a research instrument that includes two experimental scenarios and sets of questions that measure buyers’ risk propensity, adoption of buffer- and process-oriented mitigation tactics, and other control variables. The instrument instructed buyers to identify a product and supplier that they manage and to consider the scenarios with respect to this product and supplier relationship. The scenarios describe supply disruptions and facilitate a single experimental manipulation in which the likelihood of supply disruption is varied to assume high and low values. In both scenarios, the magnitude of disruption is held constant at a high level. In our research design, we purposefully focus on high-impact disruptions since interview feedback from buyers consistently indicated that disruptions having little impact on business performance receive little attention and do not motivate investments in supply-side resilience. As presented in the Appendix, Scenario 1 presents a situation having a high likelihood of supply disruption in which the supply of a product is interrupted due to a machine breakdown at a supplier. Alternately, Scenario 2 assumes a low likelihood of supply disruption, advancing a situation in which a severe winter storm results in electricity failures at a supplier and causes an interruption in supply. In both scenarios, the disruption impacts a significant portion of the buyer’s total purchase volume. For our analyses, the likelihood of supply disruption reflects the experimental manipulation in the scenarios; it is coded as a dichotomous variable such that 0 represents the low likelihood of supply disruption (i.e. Scenario 2) and 1 reflects the high likelihood of supply disruption (i.e. Scenario 1).

The development of our risk mitigation scales was guided by the conceptual work of Zsidisin and Ellram (2003), iterative interviews and pre-testing. Specifically, we interviewed buyers, purchasing managers and directors in the supply management organization of a Tier 1, global automotive supplier to understand the type of risk mitigation strategies used in practice. These interviews were supplemented with those from Tier 2 automotive suppliers. Importantly, our interviews employed an iterative process such that risk mitigation tactics (and other supply risk constructs) were identified and refined over the repeated discussion. Then, we pre-tested the risk mitigation tactics using an approach whereby the risk mitigation tactics were embedded in a survey questionnaire, buyers completed the questionnaire under our supervision and at the end of the risk mitigation section, buyers were invited to modify the wording of existing tactics or identify new tactics to ensure that the instrument included a comprehensive set of well-understood risk mitigation tactics employed in practice.

The finalized risk mitigation items (see Appendix) were presented in the research instrument following each scenario. To facilitate response, research participants were instructed to select the tactic or tactics, using a binary yes/no response scale, that they would implement to mitigate the supply risk presented in each scenario. Buffer-oriented mitigation tactics included holding safety stock at the supplier’s premises, holding buffer stocks at your own (i.e. buyer’s) premises, establishing multiple supply sources and avoiding risks by divesting from certain markets or discontinuing the exchange relationship with the supplier. The process-oriented risk mitigation strategies were presented as
certifying suppliers, implementing quality management programs for suppliers, supplier development initiatives and controlling, sharing or transferring risk. The buffer- and process-oriented tactics were randomly ordered and comingled in the list so that these overarching risk mitigation strategies were not readily apparent to respondents.

To facilitate analyses, we created formative scales to indicate buyers’ adoption behaviors. Specifically, the adoption of mitigation tactics (as referenced in $H_{1a}$ and $H_{2a}$) reflects the sum of all mitigation tactics selected in response to each scenario. The adoption of buffer- and process-oriented mitigation tactics reflects the number of buffer- and process-oriented mitigation tactics, respectively, selected for each scenario; together, these measures are used to assess buyer’s preference for buffer-oriented mitigation tactics (as posited in $H_{1b}$ and $H_{2b}$). It is important to acknowledge that though we employ similar risk mitigation tactics and strategies, our approach contrasts with Zsidisin and Ellram (2003) who model buffer- and process-oriented mitigation tactics as reflective scales. This difference is attributable to our relatively finer-grained unit of analysis. Whereas Zsidisin and Ellram (2003) assess buyers’ general engagement in mitigation activities for all suppliers and situations using continuous response scales, we alternatively focus on buyers’ (yes/no) adoption of mitigation tactics in response to experimental scenarios – i.e., specific disruptions incurred with a singular supplier and purchased product.

We adopt the risk propensity scale developed and validated by Weber et al. (2002). As shown in the Appendix, this scale is comprised of 12 items that capture risk-taking tendencies associated with investment, gambling, safety, recreation, ethics, among others. Each item was rated using a five-point Likert response scale. To avoid possible response biases, we positioned this scale near the end of the survey, i.e., after the questions on risk mitigation tactics.

As listed in the Appendix, the research instrument also includes measures of the control variables. Firm size reflects the number of employees. Geographic location is coded as two dichotomous variables contrasting respondents located in Western Europe vs those in the USA and non-Western Europe vs those in the USA. Cross-country exchange reflects the location of the buyer as compared to the location of the supplier; it is coded as a dichotomous variable where supply relationships that span countries’ borders assume a value of “1” and those involving domestic exchange are set to “0”.

4.2 Sample and data collection

While the unit of analysis for this study is a supply risk event, our unit of observation is the individual buyer; this enables us to draw conclusions on how buyers make risk mitigation decisions. As such, our target population consists of experienced and active purchasing professionals who are responsible for the operational and strategic tasks of the buying process for a national or international service or manufacturing company. Accordingly, our sample frame is comprised of experienced, active purchasing managers who subscribe to a procurement group on LinkedIn. This procurement group was set up exclusively for “experienced” professionals having more than five years of experience in the procurement field. To ensure that our sample frame consists of “active” purchasing professionals, we only invited purchasing professionals who actively participated in the discussion group in the two weeks preceding survey administration. In addition, we targeted professionals who worked for organizations with more than 50 employees and held functional titles related to purchasing at the strategic level of their organizations. Consultants and HR professionals were omitted from our study. Accordingly, 82.3 per cent of our respondents have more than five years of work experience in purchasing. We set up a web-based questionnaire which was easily accessible by our sample who received a direct link. Reminders were sent two weeks after the initial invitation to participate in the study. In total, the questionnaires reached 287 respondents during the data collection period; 113 questionnaires were completely filled out. This corresponds to a response rate of 39.37 per cent.
5. Data analysis
Since our unit of analysis is a supply risk event, 113 complete questionnaires result in 226 cases that served as the basis of our analyses. Within our sample, 74.3 per cent of the respondents are male. In addition, 26.5 per cent of the respondents work for companies located in the USA, while 42.5 and 31 per cent of the respondents are employed by firms in Western European and non-Western European countries, respectively.

Table I presents the descriptive statistics and correlations for between- and within-group variables. For the between-group variables, our results show several positive and significant correlations among adoption of buffer-oriented mitigation tactics, process-oriented mitigation tactics and (total) mitigation tactics for Scenario 1 (e.g. BAH, PAH and MAH, respectively) and Scenario 2 (e.g. BAL, PAL and MAL, respectively); these significant correlations across scenarios are consistent with the nested structure of the data. The analysis of within-group variables shows that, overall, buyers tend to adopt more buffer-oriented (mean = 1.50, SD = 0.90) than process-oriented mitigation tactics (mean = 1.18, SD = 1.16). Further, the bivariate correlations show that, consistent with H1a, the likelihood of supply disruption is significant and positively correlated with the buyers’ adoption of mitigation tactics (r = 0.30, p < 0.05).

5.1 Common method and non-response bias
Cross-sectional, survey-based research may be subject to a common method and non-response bias. Following the guidance of Podsakoff et al. (2003), we adopted several measures in our research design to mitigate the potential effects of common method bias. In particular, we employed interviews and a pre-test to facilitate the elimination of ambiguous and unfamiliar terms in our questionnaire. Also, we minimized the effects of the consistency motif by adopting dissimilar items and response scales and using dissimilar types of measurement scales (e.g. formative and reflective scales). Moreover, to reduce desirability bias, we rendered the questionnaire anonymous and indicated to managers that there are no right or wrong questions. To test for the possible effects of common method bias, we use the marker variable approach developed by Lindell and Whitney (2001). Consistent with their approach, we employ a theoretically unrelated item, “the supplier is on the lookout for a buyer to replace us”, as our marker variable and assess the correlation of this marker variable with each other variable in our model. Our results show that the marker variable maintains a negligible correlation with risk propensity (r = −0.006). This finding suggests that common method bias does not threaten the validity of our study. We also assess the potential for non-response bias by comparing early vs late responders across several demographic variables, including the number of employees, revenues and locations of respondents’ firms (Armstrong and Overton, 1977). Our results, which show no significant differences (p > 0.05) across groups, suggest that non-response bias is not problematic.

5.2 Scenario and measurement validity
To examine the efficacy of our experimental manipulation, we followed the general approach of Sitkin and Weingart (1995) and asked respondents to assess the likelihood of disruption associated with each scenario and then contrasted response data across scenarios. As expected, results from our test of mean difference show that respondents perceive the likelihood of disruption as significantly greater in the first scenario as compared to the second scenario (t = 7.864, p < 0.001). Consistent with prior behavioural studies (e.g. Bachrach and Bendoly, 2011; Rungtusanatham et al., 2011), we also asked respondents to rate the realism of each scenario using a three-item scale; the mean for each of these items was above the midpoint of the response scale indicating that respondents indeed perceive the scenarios to be realistic. These findings validate our experimental manipulation and, consequently, our measure of the likelihood of supply disruption.
### Table I. Descriptive statistics and correlations

<table>
<thead>
<tr>
<th>Between-group variables (n = 113)</th>
<th>Bivariate correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean SD</td>
<td>BAL</td>
</tr>
<tr>
<td>Buffer adoption-low LSD (BAL)</td>
<td>1.35</td>
</tr>
<tr>
<td>Process adoption-low LSD (PAL)</td>
<td>0.86</td>
</tr>
<tr>
<td>Mitigation adoption-low LSD (MAL)</td>
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</tr>
<tr>
<td>Buffer adoption-high LSD (BAH)</td>
<td>1.65</td>
</tr>
<tr>
<td>Process adoption-high LSD (PAH)</td>
<td>1.50</td>
</tr>
<tr>
<td>Mitigation adoption-high LSD (MAH)</td>
<td>3.14</td>
</tr>
<tr>
<td>Risk propensity (RP)</td>
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<td>Firm size (FS)</td>
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<td>Location-Western Europe (WE)</td>
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<tr>
<td>Location-non-Western Europe (NE)</td>
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<tr>
<td>Cross-country exchange (CE)</td>
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</table>

<table>
<thead>
<tr>
<th>Within-group variables (n = 226)</th>
<th>Bivariate correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean SD</td>
<td>LSD</td>
</tr>
<tr>
<td>Likelihood of supply disruption LSD</td>
<td>-</td>
</tr>
<tr>
<td>Buffer adoption (BA)</td>
<td>1.50</td>
</tr>
<tr>
<td>Process adoption (PA)</td>
<td>1.18</td>
</tr>
<tr>
<td>Mitigation adoption (MA)</td>
<td>2.67</td>
</tr>
</tbody>
</table>

**Notes:** Bold indicates $p \leq 0.05$ (two-tailed); bold and italics indicate $p \leq 0.01$ (two-tailed). "Low LSD = low likelihood of supply disruption (Scenario 2); high LSD = high likelihood of disruption (Scenario 1)"
We employ both formative and reflective scales to measure the focal constructs of our theoretical model. We adopt formative scales to measure buffer- and process-oriented mitigation strategies; consistent with the formative approach, each scale consists of a comprehensive set, i.e., “census”, of tactics that inform each strategy (Bollen and Ting, 2000; Wilcox et al., 2008). As described in the Research Design section, scale development involved an extensive literature review, comprehensive interviews and a pre-test; moreover, our pre-test and final survey administration provided open response prompts following each scenario for respondents to adopt mitigation tactics not listed in the instrument. This multi-step approach facilitates valid construct definitions and an inclusive set of formative indicators that fully represent the conceptual domain of each formative construct thereby establishing two important requirements for valid formative scales – i.e., content specification and indicator specification (Diamantopoulos et al., 2008). For our reflective scale, we assess the reliability of risk propensity using Cronbach’s α; our result (α = 0.70) establishes the convergent validity of this scale. To support the discriminant validity of the risk propensity measure, we find that the average variance extracted for this scale exceeds its squared correlation with each other scale. In aggregate, our instrument development approach and empirical findings support the validity of our formative and reflective measurement scales.

5.3 Results
We test our hypotheses using general structural equation models (GSEMs) with multilevel latent variables in STATA (v15). In this approach, we employed multilevel latent variables to account for the hierarchical structure of our data in which scenarios are nested within individuals. Alternately, GSEMs allow for the estimation of simultaneous equations – i.e., the assessment of effects for multiple dependent variables in a single estimation – while also accounting for the hierarchical structure of our response data. Following the recommendations of Heck et al. (2014) for multilevel analyses, we initially estimated the null (random intercept) model to assess the distribution of between- and within-group variance, and compute the intraclass correlation coefficient (ICC) for each dependent variable in our analyses. Our results show that ICCs for the adoption of mitigation tactics (ICC = 0.409, \( p < 0.05 \)), the adoption of buffer-oriented mitigation tactics (ICC = 0.298, \( p < 0.05 \)) and the adoption of process-oriented mitigation tactics (ICC = 0.402, \( p < 0.05 \)) are significantly greater than 0. These results confirm that our data are nested and therefore require a multilevel approach to properly account for the correlation of error terms within individuals.

We rely on model fit indices to determine our specific estimation approach for the random effects. Specifically, for each dependent variable, we compare the Akaike information criterion (AIC) and Bayesian information criterion (BIC) for random intercept estimation and random intercept and slope estimation. The results show that random intercept estimation yields better model fit (i.e. lower AIC and BIC) for the adoption of mitigation tactics, the adoption of buffer-oriented mitigation tactics and the adoption of process-oriented mitigation tactics. Hence, we use the simpler random intercept approach to estimate random effects in the subsequent analyses.

To assess \( H1a \) and \( H2a \), we estimate the effects of the likelihood of supply disruption, risk propensity and control variables on the adoption of mitigation tactics. Table II, which reports the fixed effects, shows that the likelihood of supply disruption (\( B = 0.938, \ p < 0.001 \)) is significantly and positively related to the adoption of risk mitigation tactics. Consistent with \( H1a \), as the likelihood of disruption increases from Scenario 2 to Scenario 1, buyers increasingly adopt mitigation tactics. Our results also support \( H2a \): risk propensity (\( B = -0.493, \ p = 0.010 \)) is significantly and negatively related to the adoption of mitigation tactics.
We employ a two-step approach to test $H1b$ and $H2b$ – i.e., the effects of the likelihood of supply disruption and risk propensity on the preference for buffer-oriented mitigation tactics. For these hypotheses, preference may be intuitively modelled as the difference of the adoption of buffer-oriented mitigation tactics minus the adoption of process-oriented mitigation tactics. However, as Edwards (1995) argues, the use of a difference score as a dependent variable is problematic because it results in biased estimates. To address this issue, Edwards (1995) mathematically derives an alternate approach in which the difference score is divided into its constituent elements, which serve as the dependent variables for subsequent analysis; the effects of independent variables on each dependent variable are assessed simultaneously; and significant differences in effects for the same independent variables across simultaneous equations indicate that these independent variables significantly affect the difference in dependent variables.

Following the approach developed by Edwards (1995) and implemented by Mullins et al. (2014), we initially estimate the simultaneous effects of the likelihood of supply disruption, risk propensity and control variables on the adoption of buffer-oriented tactics and the adoption of process-oriented tactics. The fixed effects listed in Table III show that the likelihood of supply disruption is significantly and positively related to the adoption of buffer- ($B = 0.301, p = 0.002$) and process-oriented mitigation tactics ($B = 0.637, p < 0.001$). In addition, we find that risk propensity significantly and negatively affects the adoption of buffer- ($B = -0.192, p = 0.077$) and process-oriented mitigation tactics ($B = -0.300, p = 0.039$). Next, we conduct post-hoc Wald tests to assess the differential effects of the likelihood of supply disruption and risk propensity on buffer- and process-oriented mitigation tactics, respectively. Specifically, for $H1b$, we test whether the effect of the likelihood of supply disruption on the adoption of buffer-oriented mitigation tactics ($B = 0.301$) is equivalent to the effect of the likelihood of supply disruption on the adoption of process-oriented mitigation tactics ($B = 0.637$). The result of the Wald test supports $H1b$ ($\Delta \chi^2(1) = 5.73, p = 0.0167$): as the likelihood of supply disruption increases (from Scenario 2 to Scenario 1), buyers adopt significantly less buffer- as compared to process-oriented mitigation tactics. To test $H2b$, we apply the Wald test to similarly contrast the effect of risk propensity on the adoption of buffer- ($B = -0.192$) vs process-oriented mitigation tactics ($B = -0.300$). We find no support for $H2b$ ($\Delta \chi^2(1) = 0.35, p = 0.5516$); this finding suggests that as risk propensity increases, there is no significant difference in the buyers’ adoption of buffer- vs process-oriented mitigation tactics.

6. Discussion
This study advances the resilience-as-balance perspective which suggests that resilience reflects the alignment of mitigation capabilities with vulnerabilities faced by a supply chain. In the context of supply-side resilience, which focuses on the upstream supply chain, we

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>SE</th>
<th>t-value</th>
<th>Two-tailed p-value</th>
<th>Lower bound</th>
<th>Upper bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>4.115</td>
<td>0.516</td>
<td>7.99</td>
<td>&lt;0.001</td>
<td>3.105</td>
<td>5.124</td>
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<tr>
<td>Likelihood of supply disruption</td>
<td>0.938</td>
<td>0.131</td>
<td>7.17</td>
<td>&lt;0.001</td>
<td>0.682</td>
<td>1.194</td>
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<tr>
<td>Risk propensity</td>
<td>-0.493</td>
<td>0.191</td>
<td>-2.58</td>
<td>0.010</td>
<td>-0.866</td>
<td>-0.119</td>
</tr>
<tr>
<td>Firm size</td>
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<td>-0.059</td>
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<tr>
<td>Geographic location (Western Europe)</td>
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<td>0.695</td>
<td>-0.476</td>
<td>0.713</td>
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<tr>
<td>Geographic location (non-Western Europe)</td>
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<td>0.015</td>
<td>0.149</td>
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<tr>
<td>Cross-country exchange</td>
<td>0.429</td>
<td>0.244</td>
<td>1.76</td>
<td>0.078</td>
<td>-0.049</td>
<td>0.907</td>
</tr>
</tbody>
</table>

Table II.
The adoption of mitigation tactics – multilevel general structural equation modela

Note: aModel fit: log likelihood = -379.99221
Table III. The adoption of buffer- and process-oriented mitigation tactics – multilevel general structural equation model

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Adoption of buffer-oriented mitigation tactics</th>
<th>Adoption of process-oriented mitigation tactics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parameter Estimate</td>
<td>SE</td>
</tr>
<tr>
<td></td>
<td>Intercept</td>
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<td>Likelihood of supply disruption</td>
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<td>Risk propensity</td>
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<tr>
<td>Firm size</td>
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<td>Geographic location (Western Europe)</td>
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<td>0.173</td>
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<tr>
<td>Geographic location (non-Western Europe)</td>
<td>0.462</td>
<td>0.176</td>
</tr>
<tr>
<td>Cross-country exchange</td>
<td>0.049</td>
<td>0.139</td>
</tr>
</tbody>
</table>

Notes: Bold denotes significant difference (post-hoc Wald test, \( p \leq 0.05 \)) in estimates across simultaneous equations. \(^a\)Model fit: log likelihood = \(-603.31855\)
conceptualize mitigation capabilities as supply risk mitigation tactics and vulnerability in terms of the likelihood of supply disruption. We apply risky decision-making theory to the study of supply-side resilience by considering buyers' adoption of and preference for particular mitigation tactics as risky decisions influenced by the likelihood of supply disruption and risk propensity. Integrating the resilience-as-balance perspective and risky decision-making theory, our experimental approach effectively assesses how buyers actually align, or “balance”, their selection of one or more mitigation tactics with the vulnerabilities described in the scenarios. Using this approach, our study advances an important theoretical contribution by conceptually integrating two previously disparate streams of research – i.e., the supply chain resilience and the risky decision-making bodies of literature.

Our integrated approach contributes to the advancement of risky decision-making theory in two important ways. First, we extend the generalizability of this theory by demonstrating its applicability in the context of supply-side resilience. In so doing, our study offers novel conceptualizations of the focal dependent variable of this theory – i.e., risk behaviour. For example, whereas the risky decision-making literature has a rich history of exploring gambles and potential winnings (as summarized by Das and Teng, 2001), our application instead motivates the consideration of risk behaviours largely intended to attenuate losses. Moreover, our application of risky decision-making theory prompts the operationalization of risk behaviour as the sets of related actions (i.e. tactics) that comprise risk mitigation strategies; this contrasts with the traditional applications of risky decision-making theory which largely focus on a singular decision, such as whether or not to continue an information systems project (Keil et al., 2000). Hence, our novel context and operationalization of risk behaviour extend the domain (Whetten, 1989) and boundaries (Bacharach, 1989) in which risky decision-making theory applies. Second, we find that risk propensity is significantly and negatively related to the adoption of risk mitigation strategies ($B = -0.493, p = 0.010$). The importance of this finding is underscored by Sitkin and Pablo’s (1992) seminal research, which asserts that risk behaviour is determined by two factors: risk perception and risk propensity. Yet, previous empirical studies (e.g. Keil et al., 2000; Sitkin and Weingart, 1995), which simultaneously assess the effects of risk perception and risk propensity on risk behaviour, conclude that risk propensity does not directly affect risk behaviour. Hence, our study provides initial empirical validation for a key aspect of Sitkin and Pablo’s (1992) conceptualization of risky decision making. Additionally, our results suggest that prevailing behavioural models of risk mitigation and resilience, which do not incorporate risk propensity, may be theoretically incomplete.

Our study also enables us to build upon the emerging supply chain resilience literature. Recent studies consider many predictors of resilience, including inventory management systems (Boone et al., 2013), inventory pooling (Liu et al., 2016), visibility (Brandon-Jones et al., 2014), supplier integration, collaboration and investments (Durach and Machuca, 2018; Wieland and Wallenburg, 2013), and resources and capabilities (Ambulkar et al., 2015; Brusset and Teller, 2017). Yet, notably, extant research offers little insight into how buyers actually make decisions to build resilience; hence, we explicitly consider the formative roles of the likelihood of supply disruption and risk propensity in this decision-making process. Our findings show that the likelihood of supply disruption is significantly and positively associated with the buyers’ adoption of mitigation tactics ($B = 0.938, p < 0.001$). This result is consistent with that of Ellis et al. (2010), who empirically show that the likelihood of supply disruption is positively related to the search for alternate suppliers. However, whereas Ellis et al. (2010) consider a single mitigation tactic, our study broadens consideration to include sets of related mitigation tactics that comprise buffer- and process-oriented mitigation strategies. Accordingly, our theoretical model may more accurately approximate the realities that buyers face.
Our results additionally show that the likelihood of supply disruption is significantly and positively associated with buyers’ preference for process- rather than buffer-oriented mitigation tactics ($\Delta \chi^2(1) = 5.73, p = 0.0167$). Accordingly, our findings suggest the important role of equivocality and experiential learning in buyers’ decisions to build supply-side resilience. In the development of hypotheses, we contend that infrequent supply disruptions provide little opportunity for experiential learning; the resulting equivocality motivates buyers to adopt buffer-oriented mitigation tactics which require little knowledge of the root cause of the disruption, are capable of attenuating the impact of supply disruption with relative certainty and can effectively address a wide range of vulnerabilities with relatively little effort. Alternately, supply disruptions characterized by higher likelihood enable buyers’ learning processes enabling the understanding of the sources, types and causes of disruptions; with this enhanced understanding, buyers are better positioned to implement process-oriented mitigation tactics that generally leverage product and process knowledge, require supplier coordination, and are more complex and time-consuming for buyers to implement. Hence, our results complement the findings of Talluri et al. (2013), who consider the effects of risk likelihood on mitigation tactic efficiency, by advancing empirical support for logic that explains how the likelihood of supply disruption affects buyers’ decisions to adopt mitigation tactics. Moreover, the integration of our results with those of Talluri et al. (2013) provides insights into how buyers should vs actually do adopt mitigation tactics.

Another contribution of our study centres on risk propensity, as this dispositional factor is notably absent from prior behavioural studies of risk mitigation and resilience. Our results show that risk propensity is significantly and negatively related to the buyers’ adoption of buffer- and process-oriented mitigation tactics ($B = -0.493, p = 0.010$), but is not related to buyers’ preference for buffer-oriented mitigation tactics ($\Delta \chi^2(1) = 0.35, p = 0.5516$). The former finding follows directly from risky decision-making theory: in contrast to risk-seekers, risk-averse buyers are more sensitive to potential losses and, therefore, aggressively seek to minimize potential losses through the adoption of mitigation tactics. The latter finding fails to support our theoretical explanations based on the relative levels of certainty and the ancillary benefits inherent in buffer- vs process-oriented mitigation tactics. As indicated by our results, risk-averse buyers do not prefer the enhanced certainty of mitigation through the selection of buffer-oriented tactics; rather, they are equally likely to adopt both buffer- and process-oriented tactics to protect their operations. Conversely, we find that risk-seeking buyers are not attracted to the ancillary benefits attainable through process-oriented mitigation tactics; instead, they similarly refrain from adopting both buffer- and process-oriented tactics.

Arguably, the most salient theoretical implication of our findings concerns the resilience-as-balance perspective. In particular, the positive relationship between the likelihood of disruption and the adoption of mitigation tactics supports the resilience-as-balance view: buyers increase their mitigation capabilities in accordance with the vulnerabilities that they face. However, risk propensity can distort this balance. Statistically, our results show that when the likelihood of supply disruption is held constant, buyers having differing risk propensities will be more or less likely to adopt mitigation tactics. The resulting imbalances threaten supply-side resilience and, ultimately, firm performance (Pettit et al., 2010). For example, risk-averse buyers may overly invest in buffer- and process-oriented mitigation tactics and, subsequently, bear excessive costs that reduce firm profitability (Pettit et al., 2010). Alternately, risk-seeking buyers may fail to pursue buffer- and process-oriented mitigation tactics, thereby exposing the firm to vulnerabilities. Hence, our results show how buyers may build or fail to build supply-side resilience.

These findings also serve to caution managers: the likelihood of supply disruption and risk propensity may motivate risk-mitigating behaviours that are misaligned with
organizational goals. For example, in cases where risk-seeking buyers historically experience few supply disruptions, they are predisposed to adopt fewer risk mitigation tactics and, when implemented, these tactics tend to be buffer-oriented. Moreover, risk-seeking buyers tend to adopt fewer mitigation tactics. Yet, for organizations in which supply continuity is mission-critical, such behavioural tendencies may expose the organization to unacceptable supply risk. Additionally, the preference for buffer-oriented mitigation tactics may inhibit organizational goals aimed at establishing closer relationships with strategic suppliers through collaborative inter-organizational efforts. For these cases, our results intimate the importance of individual incentives and general policies that align buyers’ actual behaviours with both supply risk conditions and organizational goals.

7. Limitations and future research

Whilst our study makes important contributions to theory and practice, it is subject to potential limitations. The descriptive statistics for the risk propensity scale suggest that the respondents to our study are relatively risk-averse. While risk-aversion may be a common attribute of purchasing professionals, this finding may also be influenced by the phrasing of measurement items that include terms such as “never” and “forging” and that might be viewed by respondents as extreme. However, this potential limitation may be minimal as the risk propensity scale was validated previously by Weber et al. (2002) and within our study. Further, as noted earlier, our reliance on a single respondent for the measures of risk propensity and the adoption of risk mitigation tactics raises concerns that our results may be influenced by common method bias. However, we incorporate the recommendations of Podsakoff et al. (2003) into our research design to mitigate this effect. Moreover, the results of our assessment, which is based on the marker variable approach of Lindell and Whitney (2001), suggest that the actual effect of this potential bias is negligible (i.e. near 0).

Despite these potential limitations, our study provides a fruitful platform for multiple streams of future research. First, whereas our study incorporates a single dimension of supply disruption – i.e., likelihood of supply disruption, future experimental research may incorporate more variants of risky situations such as the magnitude, source and type of disruption to develop a more comprehensive view of the factors that necessitate resilience. Second, whereas our study focuses on the different types of mitigation tactics that buyers adopt in response to a risky situation, future research should also consider the relative intensity with which each tactic is implemented. Finally, future research may extend the behavioural studies of resilience beyond the supply side to advance a comprehensive, true “supply chain” view of resilience by also considering internal- and customer-facing mitigation capabilities and vulnerabilities. These proposed studies may build upon our research to further refine our understanding of how buyers’ actual behaviours affect supply chain resilience.

References


Appendix. Instructions, scenarios and measurement scales

Scenarios
Please picture yourself in both of the two following scenarios. Indicate for each scenario what risk mitigation strategy you would choose in that particular situation (multiple strategies per scenario are possible). Furthermore, please consider the same product and supplier for both scenarios.

Scenario 1. The product you are purchasing from a certain supplier is of great importance for your company, the transaction volume is reasonably large (it accounts for 10 per cent of the total purchasing volume of your company). However, recently the supplier experienced a machine breakdown which stopped the production and, therefore, also the supply of this product for five days. Furthermore, there are no alternative suppliers for that particular product and your safety stock of this product lasts only for three days. In addition to that, you expect that this kind of problem is very likely to happen again in the future.

Scenario 2. The product you are purchasing from a certain supplier is of great importance for your company, the transaction volume is reasonably large (it accounts for 10 per cent of the total purchasing volume of your company). However, recently the production of the supplier was affected by electricity failure (caused by an uncommonly severe winter storm). This electricity failure stopped the production and, therefore, also the supply of this product for five days. Furthermore, there are no alternative suppliers for that particular product and your safety stock of this product lasts only for three days. In addition to that, you expect that this kind of problem is not very likely to happen again in the future.

Please refer to the scenario (above) and answer the following questions

Risk mitigation strategies
The instruction
Please indicate which strategies you would choose; multiple strategies are possible.

Buffer-oriented mitigation strategy (Formative Scale, Source: Zsidisin and Ellram, 2003)³
- require supplier to hold safety stock;
- establish multiple supply sources;
- avoid risk (e.g. divest from a certain market or discontinue relationship with supplier); and
- deploy buffer stocks.

Process-oriented mitigation strategy (Formative Scale, Source: Zsidisin and Ellram, 2003)³
- certify supplier (and its ability to meet predefined requirements);
- implement quality management programs (to measure and improve abilities of suppliers);
- develop supplier (improve its performance and capabilities); and
- control/share/transfer risk (e.g. vertical integration and determination of risk responsibility).
Risk likelihood
Please answer the following overall questions concerning your risk propensity.

Risk perception (Manipulation Check, Source: Ellis et al., 2010)
What is the likelihood of this supply problem?

Scenario realism (Scenario Realism Check, Source: Rungtusanatham et al., 2011)
The scenario reviewed above and the expected decisions are realistic.

In my past experience, I have encountered similar decision-making scenarios.
I took my assumed responsibility and decision-making seriously while answering these survey questions.

Risk propensity (Reflective Scale, Source: Weber et al., 2002)
Please indicate your likelihood of engaging in this activity or behaviour.

- investing 10 per cent of your annual income in a very speculative stock;
- going down a ski run that is too hard or closed;
- gambling a week’s income at a casino;
- using office supplies for your personal business;
- smoking a pack of cigarettes per day;
- asking your boss for a raise;
- co-signing a new car loan for a friend;
- deciding to share an apartment with someone you do not know well;
- never wearing a seatbelt;
- forging somebody’s signature;
- trying bungee jumping; and
- betting a day’s income at the horse races.

Firm size: how many employees are employed in your organization enterprise wide?
Geographic location: what is your nationality?
Cross-country exchange: where is the supplier you considered in the above-mentioned scenarios located?

Corresponding author
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