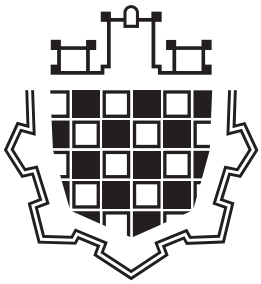

DECISION MAKING IN SUPPLY RISK AND SUPPLY DISRUPTION MANAGEMENT

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Maximilian Merath
Mannheim

Dekan: *Prof. Dr. Dieter Truxius*

Referent: *Prof. Dr. Christoph Bode*

Korreferentin: *Prof. Dr. Laura Marie Edinger-Schons*

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List of abbreviations

ANCOVA	Analysis of covariance
ANOVA	Analysis of variance
AVE	Average variance extracted
BP	British Petroleum
B2B	Business-to-business
B2C	Business-to-consumer
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CI	Confidence interval
CSIR	Corporate social irresponsibility
CSR	Corporate social responsibility
DCE	Discrete choice experiment
df	Degrees of freedom
DICO	Direct implementation costs
ESG	Environmental, social, and governance
FP	Final performance
IPT	Information-processing theory
ITA	Intention to take immediate action
KPI	Key performance indicator
M	Mean
MNL	Multinomial logit
MS	Mean square
NL	Nested logit
NTP	Number of time periods
nWOM	Negative word-of-mouth
PDP	Post-disruption performance
PI	Purchase intention
PMT	Protection motivation theory
RAF	Ready-aim-fire
RECO	Response costs
REFF	Response efficacy
RFA	Ready-fire-aim
RMSEA	Root mean square error of approximation
SD	Standard deviation
SE	Standard error
SEFF	Self-efficacy
SLO	Social license to operate
SRMR	Standardized root mean square residual
SS	Sum of squares
TLI	Tucker-Lewis index (also NNFI)
URP	Uncertainty resolution performance
VULN	Vulnerability
VW	Volkswagen

Chapter 1 Introduction and research overview

1.1 Motivation

"*The ultimate measure of a man is not where he stands in moments of comfort and convenience, but where he stands at times of challenge and controversy.*"

– Martin Luther King, Jr.

Supply chains are exposed to a myriad of risks that pose considerable challenges to managers. In case a risk materializes and creates a subsequent disruption, the potential negative consequences are devastating. Recent developments foster the vulnerability of firms to suffer from supply chain risks and add considerable relevance to the threat of being severely harmed by them. First, modern supply chains have become more complex and interconnected due to globalization and intensified competition (Bode & Wagner, 2015; Business Continuity Institute, 2016). Second, many supply chain management initiatives that appear to provide enhanced efficiency or responsiveness in stable environments turn out to be a burden for firms in turbulent ones (Norrman & Jansson, 2004). Third, the pressure that stakeholders can exert on firms to comply with ethical standards and commit to environmental and social values, especially by holding them accountable for misconduct within their supply chains, has grown (Hartmann & Moeller, 2014). Finally, not only the frequency of natural catastrophes but also their intensity has increased (Munich Re, 2017).

Prior research has shown that supply chain disruptions tend to be "more critical when they occur upstream in the chain" (Pereira, Christopher, & Lago Da Silva, 2014, p. 627). Hence, this dissertation research focuses on upstream supply chain risks (hereafter: *Supply risks*) and disruptions (hereafter: *Supply disruptions*). To manage a firm's exposure to supply risks and better prepare for supply disruptions, the responsible managers can employ two basic approaches. On the one hand, they can act proactively and aim at reducing the probability of a supply disruption to occur or mitigating the consequences of such adverse events (*supply risk management*). On the other hand, they can decide to cope with the aftermath of a materialized risk in a reactive fashion (*supply disruption management*) (Craighead, Blackhurst, Rungtusanatham, & Handfield, 2007). Various proactive and reactive activities have been delineated in prior research and the negative consequences of supply disruptions are well-known (Hendricks & Singhal,

2005b). However, and although most executives make supply risk management a top priority, many firms appear to be unprepared to cope with supply disruptions (A.T. Kearney & RapidRatings, 2018).

Certain types of supply disruptions – especially those characterized by high impact but low probability – cannot be avoided or resolved as part of daily operations management. These events need to be appropriately addressed to mitigate their potentially severe negative consequences, as highlighted by recent industry examples: An explosion at a steel supplier's plant in Nagoya, Japan, forced Toyota to halt production at all of their Japanese factories for one week (Tovey, 2016), online fashion company ASOS was exposed to massive criticism due to the identification of child workers in its supply chain (J. Webb, 2016a), and BASF suffered from a natural gas shortage that required a shutdown of one of its major factories in China (Bradsher, 2017). To effectively prepare for such sudden disruptions and mitigate their negative repercussions is a complex task.

In this regard, relatively little is known about the behavior of individuals within supply risk and supply disruption management (Macdonald & Corsi, 2013). Given the circumstance that a large fraction of the decisions concerning crisis situations is typically made by single decision makers with centralized authority (Dubrovski, 2004), it is surprising that behavioral aspects have been neglected in research on supply risk and disruptions, so far. Thus, the aim of this dissertation research is to shed light on specific research questions that cover behavioral aspects of managing supply risks and disruptions to improve our understanding of how to effectively address them. The results not only provide novel implications for theory and practice but also reveal certain fruitful avenues for future research.

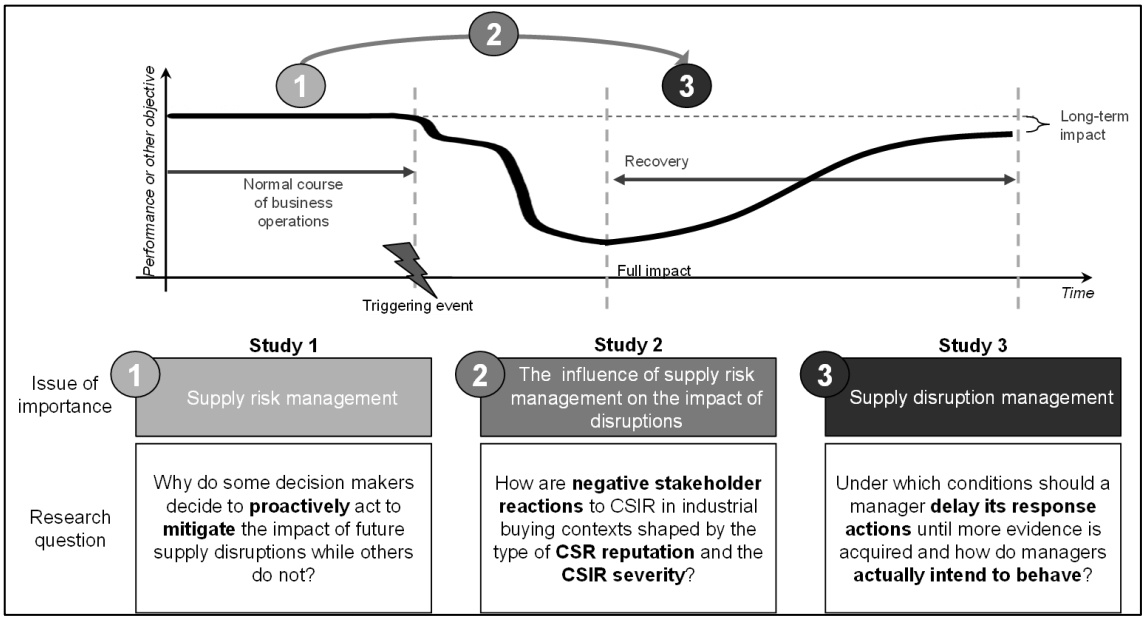
1.2 Research questions

The research questions addressed in the course of this dissertation revolve around important issues of decision making in supply risk and supply disruption management. These issues have received only limited research attention and benefit from novel insights to improve our understanding of how supply risks and disruptions can effectively be addressed. In the extant literature on supply risks and disruptions, there is an agreement that supply disruptions follow a typical profile with regard to their impact on firm performance over time (Sheffi, 2005). In case that a supply risk materializes, a subsequent

supply disruption leads to a sudden drop in operating performance. This disturbance causes firms to initiate recovery efforts to return to normal performance levels.

Figure 1 depicts this typical supply disruption profile and provides an overview of how the three research questions addressed by this dissertation are linked to it. In particular, the first research question explores why some managers act proactively to mitigate the potential loss from future supply disruptions while others do not. The second research question aims to shed light on how prior engagement in corporate social responsibility (CSR) affects negative stakeholder reactions to a materialized CSR-related risk. Finally, the third research question addresses the issue of how quickly decision makers should and do actually initiate recovery efforts after their firm has been hit by a supply disruption. Each of these research questions was approached by means of carefully designed and executed experiments to enable a controlled test of the relationships investigated. In the following, the three research questions are delineated in more detail.

Figure 1: Overview of research questions



Note. CSIR refers to corporate social irresponsibility.

1.2.1 Research question 1: Supply risk management

The overarching aim of supply risk management is to pursue a combination of activities for which the remaining amount of risk complies with the firm's risk preference and corporate strategy (Hofmann, Busse, Bode, & Henke, 2014). Although it is well-known that supply risk management is associated with certain benefits (Mitroff & Alpaslan, 2003; Norrman & Jansson, 2004), it remains largely unexplored how and why some

managers decide to take proactive action to mitigate the impact of future supply disruptions while others do not. The related managerial choices strongly influence to which degree firms are able to cope with supply disruptions. Hence, to contribute to an improved understanding of this issue, it is vital to unravel behavioral components of supply risk management.

A relatively similar problem has been investigated by health-related research. Analyzing the factors that shape an individual's decision to adopt certain preventive health behaviors, Rogers (1975, 1983) developed protection motivation theory (PMT). PMT is based on the idea that when individuals are exposed to a threat, their probability to adopt a certain coping response depends on two cognitive appraisal processes. These appraisal processes take factors into account that are associated with the costs and impact of a potential proactive action (*coping appraisal*) as well as the characteristics of a threat and the consequences of not taking proactive action (*threat appraisal*). Although PMT has initially been developed to study the effects of fear appeals on health behavior, it has moved far beyond them and is considered generalizable to "apply to any situation involving threat" (Rogers, 1983, p. 172).

PMT serves as an insightful framework to study decisions on whether or not managers proactively address supply risks and contributes to a better understanding of the role that individual managers' behaviors play within the process of managing supply risks. Hence, Study 1 in Chapter 2 employs PMT to examine proactive decision making to provide an answer to the following research question:

Research Question 1	*Why do some decision makers decide to proactively act to mitigate the impact of future supply disruptions while others do not?*

1.2.2 Research question 2: The influence of supply risk management on the impact of disruptions

Despite the growing pressure that stakeholders can exert on firms to adhere to ethical standards and behave in socially responsible ways (Campbell, 2007), the amplified public awareness and availability of information on environmental and social misconduct (Fiaschi, Giuliani, & Nieri, 2017), and the increasingly difficult challenge for firms to prevent irresponsible behavior in their supply chains (Hartmann & Moeller, 2014), the issue of corporate social irresponsibility (CSIR) in supply chains has been neglected in the academic discussion of CSR. In the academic literature on CSR, there is a strong focus on equating CSR with "doing good", although it has been shown that "avoiding bad" also

constitutes an important precondition for a firm to successfully position itself as socially responsible (Lin-Hi & Müller, 2013).

Prior research has predominantly assumed that a firm's ex ante CSR activities may serve as a "reservoir of goodwill" among the firm's stakeholders that mitigates negative reactions to CSIR (e.g., Flammer, 2013; Godfrey, Merrill, & Hansen, 2009; Jones, Jones, & Little, 2000; Klein & Dawar, 2004). However, there are reasons to seriously doubt that these insurance-like effects of ex ante CSR in case of CSIR universally apply. Several studies suggest that firms which engage in CSR experience more negative reactions to CSIR compared to firms which do not promote themselves as socially responsible (e.g., Sen & Bhattacharya, 2001; Swaen & Vanhamme, 2003; Vanhamme & Grobben, 2009). Moreover, examples like Volkswagen (VW) that won numerous awards for CSR but recently faced severe criticism due to the "Dieselgate" scandal contradict the idea of insurance-like effects of prior CSR (Lynn, 2015).

Some researchers argue that a possible explanation for these contrary effects might be that, similar to brand commitment (Germann, Grewal, Ross, & Srivastava, 2014), a reputation for CSR provides a goodwill buffer in case of non-severe CSIR but also serves as an expectation burden in case of severe CSIR (e.g., Janssen, Sen, & Bhattacharya, 2015; Kang, Germann, & Grewal, 2016). Moreover, these effects of ex ante CSR reputations in times of crises might be subject to the nature of the employed activities to gain a CSR reputation, which can either be substantive or symbolic (Ashforth & Gibbs, 1990). Substantive CSR is typically perceived as intrinsically motivated while symbolic CSR is associated with extrinsic motives. In case of CSIR, instead of assuming a lack of proper management or even malevolence, stakeholders are more willing to develop alternative explanations for CSIR if they perceive a firm's CSR engagement to be intrinsically motivated rather than extrinsically driven (Janssen et al., 2015).

Study 2 focusses on the role of the purchasing function as gatekeeper to CSIR-related risks in the supply chain of a focal firm and contributes to a better understanding of negative stakeholder reactions to CSIR. More specifically, this research investigates whether the effect of a CSR reputation on negative stakeholder reactions to CSIR in professional buying contexts depends on CSIR severity and the reputation's nature (substantive vs. symbolic). Thereby, we explore the influence of proactive CSR engagement on negative stakeholder reactions to a realized CSIR-related risk. Thus, the

research presented in Chapter 3 aims to provide an answer to the following research question:

Research Question 2	*How are negative stakeholder reactions to CSIR in industrial buying contexts shaped by the type of CSR reputation and the CSIR severity?*

1.2.3 Research question 3: Supply disruption management

Decision making in supply disruption response and recovery situations is often difficult, because choices have to be made dynamically in complex environments that are characterized by uncertainty and limited information. Under these conditions, there are two basic approaches of taking recovery decisions. Some firms defer actions until reliable information is available for a sound judgment; other firms respond immediately, even though the information at hand is cloudy or fragmented (Kleinmuntz & Thomas, 1987). Using the analogy of shooting, the first approach can be termed "ready-aim-fire" (RAF) and the second "ready-fire-aim" (RFA). Intuitively, RAF may lead to more precise actions and a better solution quality than RFA, but the time required to gather additional information may allow quicker competitors to obtain superior positions. Conversely, RFA carries the inefficiencies of trial and error and, when decisions are irreversible and path-dependent, the risk of pursuing an inferior recovery path. Hence, the key question for managers concerned with supply disruptions is: Under which conditions should a decision maker delay its recovery decision until more evidence is acquired?

It is not always trivial to select one of the two presented approaches (RAF and RFA) as highlighted by the often-cited Albuquerque fire (Latour, 2001). On March 17, 2000, a Philips plant in Albuquerque, New Mexico, was hit by lightning and caught fire (Lee, 2004). Initially, it seemed that the damage would be limited. Philips informed the two main customers of the chips produced at this plant, Nokia and Ericsson, about an expected delivery delay of one week. Yet, the responses of the two competitors were completely different. Nokia immediately put pressure on Philips and quickly collaborated with alternative suppliers to recover from the disruption with merely limited negative consequences. Ericsson adopted a "wait and see" approach and delayed remedial action until more evidence about the supply disruption had been acquired. By the time it became obvious that the damage to the clean rooms was far more severe than expected, Ericsson was not able to find an alternative supplier on short notice. As a result, Ericsson had to

delay the launch of a new product and, finally, also ceased its own handset production as a further consequence of this incident (Latour, 2001; Sheffi, 2005).

This example highlights that a firm's ability to effectively respond to supply disruptions is not only vital to its short-term performance but also essential for its long-term competitiveness. However, supply disruption management has received only limited research attention. In particular, there is a need to gain a better understanding of how the responsible managers should respond to disruptive events in their firm's upstream supply chain to quickly recover from their negative consequences (Bode, Wagner, Petersen, & Ellram, 2011; Macdonald & Corsi, 2013). Moreover, there is a need to investigate how and to which extent the responsible decision makers' intended choices deviate from how they should behave. Hence, the following research question is addressed by Study 3 as presented in Chapter 4:

Research Question 3	*Under which conditions should a manager delay its response actions until more evidence is acquired and how do managers actually intend to behave?*

Chapter 2 Supply disruptions and protection motivation: Why some managers act proactively (and others don't)

Co-authors:

Christoph Bode
Endowed Chair of Procurement, Business School, University of Mannheim, Germany

John R. Macdonald
Department of Management, Colorado State University, Fort Collins, USA

Abstract[1]

Supply disruptions present considerable managerial challenges and have severe consequences. To protect their firms from disturbances, managers must decide whether or not to take proactive measures. However, little is known about how they make these decisions. Protection motivation theory suggests that an individual's intention to respond to a threat by acting proactively results from cognitive appraisal processes. These processes evaluate the characteristics of a potential coping response (e.g., its effectiveness in averting the threat) and the threat itself (e.g., its severity). Building on this framework, this study presents an analysis of what drives managers to or deters them from responding to the threat of a supply chain disruption. The exploratory results from a discrete choice experiment show that decision makers have a strong subconscious focus on cost-related aspects of a specific proactive action, while consciously prioritizing the efficacy of the action over its costs. Thus, the study provides interesting and novel insights into behavioral aspects of supply chain risk management by revealing that decision makers' perceptions of the relative importance of proactive action attributes deviate considerably from their actual choice behavior. Additionally, proactive personality, risk attitude, control appraisal, and experience had significant effects on the relative importance of certain proactive action attributes.

[1] Merath, M., Bode, C., and Macdonald, J. R., 2018. Supply disruptions and protection motivation: Why some managers act proactively (and others don't). *Unpublished Working Paper*, 1-38. An earlier version was nominated for the "ISM Best Paper in Supply Chain Management Award" of the Operations and Supply Chain Management Division of the Academy of Management at the Annual Meeting in Chicago, IL, in 2018.

2.1 Introduction

Supply chain disruptions are "unplanned and unanticipated events that disrupt the normal flow of goods and materials within a supply chain […] and, as a consequence, expose firms within the supply chain to operational and financial risks" (Craighead et al., 2007, p. 132). Minor disruptions can often be resolved within day-to-day operations, but high impact–low probability disruptions pose serious challenges for managers. Moreover, disruptions tend to be "more critical when they occur upstream in the chain" (Pereira et al., 2014, p. 627). For example, BMW suspended production in China for one week due to supplier parts shortages (Moriyasu, 2017), BASF's U.S. plant was temporarily shut down following a disruption at an external supplier (Burger & Sheahan, 2018), and Toyota suffered from the interruptions in the supply of raw materials after a major earthquake in Japan (Tajitsu & Yamazaki, 2016). Hence, this study examines disruptions in a focal firm's upstream supply chain that cannot be resolved within daily operations management (hereafter: Supply disruptions).

There are two ways to address and manage a firm's exposure to such disruptions. Managers can either decide to proactively tackle supply disruptions with measures aimed at minimizing the probability of their occurrence or mitigating their damage (hereafter: Supply risk management), or reactively cope with the adverse effects of a materialized risk (hereafter: Supply disruption management) (Craighead et al., 2007). The overall goal of both approaches is to determine a mix of activities for which the remaining amount of risk is in line with the firm's risk preference and corporate strategy (Hofmann et al., 2014). The related choices considerably affect the degree to which firms can recover from supply disruptions (e.g., Habermann, Blackhurst, & Metcalf, 2015; Yildiz, Yoon, Talluri, & Ho, 2016), but behavioral aspects of supply risk management remain relatively unclear (Bode & Macdonald, 2017). More specifically, although the negative consequences of supply disruptions (Hendricks & Singhal, 2005a,b) and the benefits of supply risk management are well-known (Mitroff & Alpaslan, 2003; Norrman & Jansson, 2004), little is known about why some decision makers proactively act to mitigate the impact of future supply disruptions while others do not.

Health-related research faces a similar problem. Analyzing the factors that shape the decision to engage in a certain preventive health behavior, Rogers (1975, 1983) developed protection motivation theory (PMT). PMT centers upon two cognitive appraisal processes that account for the impact and costs of a potential proactive action

(coping appraisal) as well as the components of a threat and the consequences of not taking proactive action (threat appraisal). These appraisal processes ultimately affect a person's propensity of adopting a coping response. Although PMT was developed to discern the effects of fear appeals (appeals using fear as the driving motivation) on health attitudes and behavior, it has moved far beyond them and is considered applicable "to any situation involving threat" (Rogers, 1983, p. 172).

This study applies PMT to understand why managers do or do not decide to take proactive action in preparation for supply disruptions. More specifically, an extended version of the PMT framework is proposed which also integrates and accounts for certain individual characteristics that have been identified to influence proactive behavior. The proposed model was subjected to empirical scrutiny by means of discrete choice experiments, which emulated a decision making situation under uncertainty and the threat of a future supply disruption. In order to explore which factors predict managers' intent to take proactive action, the participating managers were provided with systematically manipulated choice scenarios and response options. The empirical results reveal the relative importance of specific proactive action attributes, highlight a mismatch between managers' choice behavior and perceptions, and show relationships between individual-specific characteristics and proactive action attributes. Thereby, this study contributes to a better understanding of managers' behavior when managing supply chain risks.

2.2 Protection motivation theory and propositions

There is consensus among scholars that proactive behavior involves "anticipatory action that employees take to impact themselves and/or their environments" (Grant & Ashford, 2008, p. 8). Two characteristics that distinguish proactive from reactive behavior are acting in advance and intended impact (Grant & Ashford, 2008). Proactivity means being future-focused by planning and selecting specific measures to modify the environment before certain events occur (Bandura, 2006). Moreover, proactive behavior is goal-driven and intended to bring about environmental change (Bateman & Crant, 1993).

To better understand an individual's proactive motivation, most attention has been devoted to how humans assess the likely outcomes of their behavior (S. K. Parker, Williams, & Turner, 2006) and the reasons for them to strive for a certain proactive goal (Griffin, Neal, & Parker, 2007). In the supply risk context, the purpose of taking proactive action is to protect the focal firm from future damage. Numerous studies, mostly in the

field of health, have been conducted to understand how people decide to behave when exposed to various threats (e.g., Grothmann & Reusswig, 2006; Sheeran, Harris, & Epton, 2013). In line with these research efforts, several cognitive behavioral theories attempt to explain how proactive behavior is initiated, but they vary with regard to the assumed mediating processes and their applicability to different contexts. All major cognitive behavioral models originated in expectancy-value theories (Hovland, Janis, & Kelley, 1953). The premise of the family of expectancy-value theories is that an individual's intention to adopt a specific behavior depends on his or her expectations of its consequences and its value. Expectancy-value theories were used to shed light on the effects of fear appeals, which are "persuasive messages with the intent to motivate individuals to comply with a recommended course of action through the arousal of fear associated with a threat" (A. C. Johnston & Warkentin, 2010, pp. 550-551).

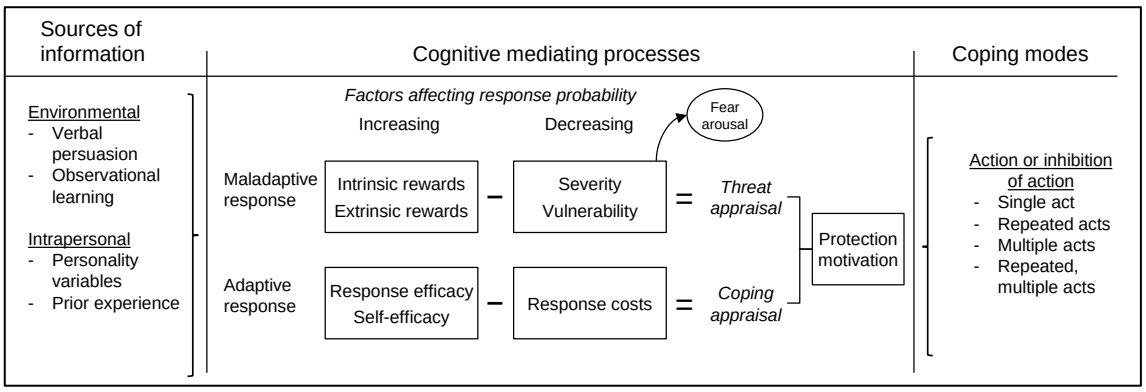
Three stimuli form a typical fear appeal. The first constitutes a value component and the other two shape expectations: (1) The magnitude of an event's harmfulness (value component), (2) the probability that this event will occur given that no protective behavior is adopted or existing behavior is modified (expectancy component), and (3) the availability and effectiveness of a coping response that might prevent adverse consequences of the event (expectancy component).

Based on expectancy-value theories, PMT was originally developed to study the impact of fear appeals on health-related behavior and support their effective design (Rogers, 1975). Its revised version (Rogers, 1983) has enabled the theory to evolve and encompass not only health-related threats – where it has been successfully applied (Floyd, Prentice-Dunn, & Rogers, 2000) – but also nuclear actions (Axelrod & Newton, 1991), and, more recently, technological or environmental hazards (Boss, Galletta, Lowry, Moody, & Polak, 2015; Y. Chen & Zahedi, 2016). PMT has become "sufficiently broad to apply to any situation involving threat" (Rogers, 1983, p. 172) and is considered "an established, robust theoretical foundation for the analysis and exploration of recommended actions or behaviors to avert the consequences of threats" (A. C. Johnston & Warkentin, 2010, p. 552). In line with this, we suggest that PMT offers an adequate and insightful framework to improve our understanding of how the threat of an impending supply disruption translates into proactive action. More specifically, it allows us to investigate the drivers of, and impediments to, an individual's motivation to take proactive action. PMT has received widespread empirical support (A. C. Johnston &

Warkentin, 2010) and provides an effective theory for human behavior which overcomes many conceptual problems leading to low correlations between attitudes and behavior (McGuire, 1985).

Figure 2 depicts the revised version of PMT (Rogers, 1983), which assumes that several sources of information about an impending threat, categorized as either environmental or intrapersonal, may initiate PMT's key mediating processes. These sources of information comprise, for example, prior experience or observational learning. Both prior experience and observational learning are considered important triggers of adaptation processes in supply disruption management (Bode et al., 2011; Hora & Klassen, 2013). In addition, it is important to note that "any source of information can lead to any of the mediating processes" (Rogers, 1983, p. 167).

Figure 2: Overall model of protection motivation theory (based on Rogers (1983))



The mediating processes at the core of PMT are *coping appraisal* and *threat appraisal*. The former evaluates the adaptive response (e.g., taking proactive action to prevent damage), while the latter assesses the maladaptive response (e.g., maintaining the status quo). Each process comprises variables that either increase or decrease the probability of adopting the respective response. As shown in Figure 2, the evaluation of the variables within each appraisal process is assumed to summate algebraically into a final appraisal of coping as well as threat; a protection motivation. Finally, both processes affect the strength of this motivation, which determines whether or not proactive action is taken. Protection motivation can be understood as a behavioral intention that may result in a single act, repeated acts, multiple acts, or repeated multiple acts that involve either direct action or its inhibition. Feedback from coping behavior will enter the PMT model as "prior experience" for reappraisals of threats and coping responses to adjust an individual's protection motivation (Rogers & Prentice-Dunn, 1997).

2.2.1 Coping appraisal

An adaptive response aims at proactively coping with the potential negative consequences associated with a threat. The coping appraisal process evaluates the ability of an individual to cope with and avert being harmed by the threat. Three major components lead to the overall evaluation of coping: *Response efficacy* and *self-efficacy* increase an individual's willingness to perform a proactive action; the *costs* associated with the response decrease it. Response efficacy is the perception that a specific proactive action will avert the dangers of a threat. Self-efficacy is the belief in one's ability to successfully perform a specific action. It was proposed to be a major component of almost all processes of psychological change and exerts a considerable influence on whether or not a certain behavior is chosen and how much effort will be invested in its execution (Bandura, 1977). However, the concept of self-efficacy had largely been neglected in any of the social-cognitive behavioral models based on expectancy-value theories. The revised version of PMT was the first of these models to incorporate self-efficacy into the study of proactive decision making behavior (Rogers, 1983). Finally, any costs of adopting the adaptive response refer to its response costs which will reduce the appeal of a specific response option. Response costs can refer to financial costs as well as inconvenience, time, and effort (Grothmann & Reusswig, 2006).

Hence, the coping appraisal process of PMT suggests that decision makers assess the appeal of a specific proactive action alternative on the basis of three characteristics: (1) The effectiveness of the alternative (*response efficacy*), (2) an individual's ability to successfully perform the action (*self-efficacy*), and (3) the costs associated with taking the proactive action alternative (*response costs*). Formally:

Proposition 1. *Individual decision makers select proactive action alternatives to prepare for the threat of an impending supply disruption based on*
(a) an alternative's effectiveness,
(b) perceived self-efficacy, and
(c) the costs associated with an alternative.
If an alternative offers an attractive package in terms of these criteria, it is more likely to be chosen.

2.2.2 Threat appraisal

A maladaptive response exposes an individual or a firm to a threat (e.g., being "unprepared" for a supply disruption), and is composed of intrinsic rewards, extrinsic rewards, severity, and vulnerability (see Figure 2). *Intrinsic rewards* and *extrinsic*

rewards increase the probability of choosing a maladaptive response. In contrast, the *severity* of a threat and the expectancy of being exposed to the threat (*vulnerability*) reduce the attractiveness of a maladaptive response. Severity is the potential amount of physical or economic damage associated with a threat (Rogers & Prentice-Dunn, 1997). At the same time, although fear was initially seen as an essential mediating variable of the effect of fear appeals on behavior, it is not considered to have a direct influence on protection motivation. It merely has an indirect impact through the evaluation of a threat's severity; therefore, fear is treated as "an insignificant byproduct of threat appraisal" (Tanner, Hunt, & Eppright, 1991, p. 37) to underline the "importance of cognitive processes rather than visceral ones" (Rogers, 1983, p. 169). PMT posits that the motivation of an individual to take a maladaptive response will decrease if the threat is severe, the vulnerability to the threat is high, one is able to successfully perform a proactive action, and this response can effectively avert the threat's potential negative consequences. A maladaptive response's likelihood will increase if the response is accompanied by rewards and performing the proactive action is costly.

Prior research using the PMT framework revealed serious difficulties in operationalizing the rewards of a maladaptive response as distinct from the costs of a proactive action. For this reason, the vast majority of PMT research has neglected the rewards component and response costs have to date not been extensively researched. Although these components are delineated as conceptually different (Rogers, 1983), the distinction between them might not be clear to managers who could perceive them as equal (maladaptive response rewards could be perceived as avoiding the costs of a proactive action). In line with prior research, to avoid duplicating the same factor, we focus on response costs (Grothmann & Reusswig, 2006; A. C. Johnston & Warkentin, 2010; Tanner et al., 1991).

The vulnerability to a specific threat may affect the relative importance of response costs. In other words, the vulnerability of a firm to a specific supply disruption might moderate the influence of a proactive measure's costs on the decision whether to take action. If a proactive measure is very costly, a high vulnerability to an impending disruption may also increase intentions to act proactively due to the higher expected loss associated with the materialized risk (Knemeyer, Zinn, & Eroglu, 2009; Norrman & Jansson, 2004). Thus, we propose the following:

Proposition 2. *The relative importance of response costs for the probability of choosing a specific proactive action to cope with a supply disruption is reduced by the vulnerability of a firm to a supply disruption.*

Although PMT presents the two appraisal processes in an unordered fashion, later studies suggest that threat appraisal precedes coping appraisal (Scherer, 1984, 1988; Tanner et al., 1991). We follow the notion of an ordered sequence between the two mediating processes in our experimental design, which will be explained in the methodology section.

2.2.3 Individual characteristics

Finally, certain characteristics of individual decision makers and of the situation arguably influence proactive behavior in organizations (S. K. Parker et al., 2006). Based on the results of a cross-cultural longitudinal study that revealed several key antecedents of proactive behavior, Frese and Fay (2001) theorized that those antecedents associated with individual decision makers can be categorized as (1) personality, (2) orientations, and (3) knowledge, skills, and abilities.

First, personality refers to individual differences that represent proclivity for action and cross-situational tendencies that activate decision makers. It has been argued that *proactive personality* is the most relevant individual predictor of proactive behavior. It is defined as a disposition toward taking action to bring about change and influence the environment (Bateman & Crant, 1993; S. K. Parker et al., 2006). In addition, since this study investigates a decision involving risk, we argue that an individual's *risk attitude* specifies how important a certain risk is to an individual and has a strong influence on his or her proactive decision making behavior (Heckmann, Comes, & Nickel, 2015). Different perceptions of the importance of a certain risk may considerably influence decision making processes and resulting outcomes. Generally, three manifestations of a decision maker's risk attitude are distinguished: Risk-averse, risk-neutral, and risk-seeking (Weber & Milliman, 1997). Prior research has shown that, depending on their risk attitude, different decision makers may perceive the same risk situation quite differently which has repercussions on choice behavior (March & Shapira, 1987).

Second, in contrast to the cross-situational and rather general personality factors, orientations are "behavior tendencies of moderate situational specificity" (Fay & Frese, 2001, p. 106). Orientations motivate proactive behavior by making a person believe that

such behavior is possible and can produce the desired results. Frese and Fay (2001) proposed that an important orientation for promoting proactivity is a person's *control appraisal*: An individual's expectation of his or her impact on work outcomes. Decision makers who assume that their own decisions have a strong effect on their work outcomes are more likely to engage in proactive action while low levels of control appraisal inhibit proactive action (Aspinwall & Taylor, 1997).

Finally, knowledge, skills, and abilities capture an individual's capacity to identify work-related challenges, analyze them, and develop appropriate solutions (Hunter, 1986). Hence, a person's understanding of a task determines the ability to act proactively. As an indicator of an individual's knowledge, skills, and abilities, *experience* considerably affects intention to act proactively. Work experience has been identified as a main driver of knowledge, and hence, of the development of skills and techniques that improve job performance (F. L. Schmidt, Hunter, & Outerbridge, 1986). Following prior research, more experienced decision makers might be more likely to act proactively, because they possess the requisite knowledge and skills to successfully engage in proactive behavior (Grant & Ashford, 2008; Grant, Parker, & Collins, 2009).

Based on the framework developed by Frese and Fay (2001), it is proposed that these four characteristics affect proactive behavior by influencing the relative importance of PMT's coping appraisal components:

Proposition 3. *The relative importance of PMT's coping appraisal components for the probability of choosing a specific proactive action is influenced by characteristics of individual decision makers, namely their*

(a) proactive personality,
(b) risk attitude,
(c) control appraisal, and
(d) experience.

2.3 Methodology

To evaluate the developed propositions and analyze the factors influencing decisions to engage in proactive preparation for supply disruptions, a discrete choice experiment (DCE) was developed. DCEs are considered an effective way to analyze complex decision making tasks and choice behavior (Louviere, Hensher, & Swait, 2000; Moore, Gray-Lee, & Louviere, 1998). Although they have successfully been applied to analyze choice behavior in fields such as marketing, economics, or health research, they have only rarely been used in operations management (e.g., E. J. Anderson, Coltman, Devinney, &

Keating, 2011; Coltman & Devinney, 2013; Pullman, Verma, & Goodale, 2001; Verma, Louviere, & Burke, 2006). DCEs expose participants to multiple choice situations with at least two possible response alternatives. Each specific choice situation (comprised of several choice alternatives) is referred to as *choice set*. The response alternatives in a choice set consist of a set of attributes. If no alternative option outperforms the others on all attributes, decision makers must perform trade-offs between these observed characteristics of response alternatives. This is described in further detail in the experimental design section. Regardless of whether these trade-offs are determined consciously or subconsciously, stated choice preferences reveal the underlying weight or importance assigned to specific attributes (E. J. Anderson et al., 2011).

2.3.1 Experimental design

The developed experimental design exposed all participants to nine choice sets comprising three possible response options. The order of choice sets presented was randomized for each participant to control for order effects (Potoglou & Kanaroglou, 2007). For each choice set, two of the presented alternatives were generic proactive response actions: "Proactive action A" and "proactive action B". These alternatives varied along one or more attributes of interest. Since decisions involving supply risk in practice also allow individuals to refrain from taking proactive action, a third "no choice" alternative labelled "neither" was included.[2] Whether to include an opt-out alternative is an important methodological issue and is becoming the norm in choice experiments (J. R. Parker & Schrift, 2011). Failure to include a "no choice" option may distort the results by overestimating participation by forcing some participants to choose (Boyle, Holmes, Teisl, & Roe, 2001). In addition, offering an opt-out option improves the realism of experiments (Louviere et al., 2000).

A D-optimal[3] design allows for an analysis of the attributes' main effects and the proposed interactions. To ensure participants' understanding of the discrete choice format, an additional tenth choice set was included as a consistency check (Green &

[2] We also included the following description to add a more nuanced and realistic notion of what choosing the "no choice" option actually meant: "Neither, because none of the other response alternatives seem appropriate."

[3] D-optimality (or D-efficiency) is a widely used and well-established metric in the design of choice experiments. In order to construct statistically efficient designs, D-optimal designs maximize the Fisher information matrix (the determinant of the variance-covariance matrix of the model to be estimated) (Hensher, Rose, & Greene, 2005).

Gerard, 2009). In this tenth set, one of the two proactive actions was clearly constructed as the dominant alternative (i.e., all attribute levels were more desirable). Thus, to "pass" the consistency check, respondents had to choose either the dominant or the "no choice" alternative. At the end of the experiment, participants responded to a brief survey to collect individual-specific data.

Scenario Design.[4] To ensure that the participants were provided with the same contextual information, they were given a carefully designed introductory paragraph to read before they were shown the choice sets. This *common module* delineated the underlying choice scenario from the perspective of a third person to limit demand characteristics and effects of social desirability (Fisher, 1993; Thomas, Thomas, Manrodt, & Rutner, 2013). In this scenario, a procurement manager observes that an earthquake in Asia has caused a serious supply disruption to a competitor. This manager also sources parts from Asia so his or her firm is vulnerable to a similar supply disruption. Hence, the manager needs to decide whether or not to mitigate future potential losses by taking proactive action. By framing the choice situation in a vicarious learning context, we account for the relevance of observing other firms as an important source of information in supply risk and disruption management and increase the experiment's realism (Hora & Klassen, 2013). Moreover, supply disruptions due to natural disasters frequently inflict substantial damage on firms involved (e.g., Helft & Bunkley, 2011; Tajitsu & Yamazaki, 2016; J. Webb, 2016b).

The description of the underlying choice situation discusses the threat appraisal variables of PMT. First, the potential damage of disruption caused by an earthquake was described as severe (severity). This is important, because of the focus on high-impact supply disruptions that cannot be resolved in daily operations management. Second, we systematically manipulated the probability that the disruption will harm the decision maker's firm (vulnerability). We distinguished *low* from *high* vulnerability by varying the earthquake-proneness of the Asian supplier's location in the description. Participants were randomly assigned to one of these two treatment conditions to assess whether or not vulnerability moderates the effect of response costs on choice behavior. In this way we

[4] Although DCEs and vignette-based experiments pursue different aims (DCEs: Interested in trade-offs between attributes; Vignette-based experiments: Investigate the impact of certain variables on observed intentions or actual behavior), both approaches share similarities with regard to how information about an a priori defined role and/or situation is presented to respondents. Hence, scenario design and validation was partly based on recommendations for vignette-experiments (e.g., Aguinis & Bradley, 2014; Rungtusanatham, Wallin, & Eckerd, 2011).

eliminate systematic differences in the respondents to be able to attribute differences in response behavior to the treatment condition (Bachrach & Bendoly, 2011). The scenario descriptions can be found in Table 1.

To assess the realism of the developed scenario and whether the participants perceived both levels of vulnerability and the potentially severe impact of the impending disruption as intended (Wason, Polonsky, & Hyman, 2002), we pre-tested the DCE with 72 graduate students. Responses to manipulation checks resulted in significantly different mean responses for low and high levels of vulnerability. Moreover, high severity was appropriately represented and the two scenario descriptions with varying degrees of vulnerability appeared realistic with means of 5.29 and 5.56 (grand mean is 5.44), evaluated on a 7-point Likert-type scale (1 := "not at all" to 7 := "completely"). The results of the DCE task were analyzed and used as priors for the generation of the D-optimal design of the DCE.

Table 1: Scenario descriptions

Introduction and severity	Leo is procurement manager for Eletrox and is responsible for buying microchips. Two weeks ago, Eletrox's major competitor was **severely** hit by a supply disruption in Asia that caused this firm to cease its own production for three days and suffer **immense** losses. An earthquake destroyed large parts of its supplier's production facilities and inventories. In order to prepare for comparable future events, this competitor subsequently implemented proactive measures.	
Factor	**Manipulated factor levels**	
Vulnerability	**Low**	**High**
	Eletrox also buys microchips from Asia and could be severely hit by such a disruption. Leo considers taking proactive action to mitigate future losses. Eletrox's microchip supplier is located in an only **slightly earthquake-prone** region. Hence, its vulnerability to earthquake-related supply disruptions in Asia is **low**.	Eletrox also buys microchips from Asia and could be severely hit by such a disruption. Leo considers taking proactive action to mitigate future losses. Eletrox's microchip supplier is located in a **very earthquake-prone** region. Hence, its vulnerability to earthquake-related supply disruptions in Asia is **high**.

Attributes and Their Levels. In the early design stages of a DCE, relevant attributes for the decision task need to be identified. The coping appraisal process of PMT suggests that decision makers assess the appeal of a specific proactive action alternative based on three characteristics: (1) The effectiveness of the response alternative in averting or mitigating a threat (*response efficacy*), (2) an individual's ability to successfully perform the action (*self-efficacy*), and (3) the costs of implementing the potential proactive action alternative (*response costs*). To appropriately represent these characteristics without making the task too complicated for the participants, each variable was operationalized

as binary with a low and a high level, by means of appropriate descriptions. Since prior research indicates that proactive measures are not only accompanied by direct financial costs but also have the potential to harm the relationship with a supplier (e.g., Heide, Wathne, & Rokkan, 2007; Zsidisin & Ritchie, 2008), we distinguished two types of response costs: Direct implementation costs and negative side effects on the respective buyer-supplier relationship (relationship costs). For instance, if a supplier formerly used as a single source for a specific part loses a considerable fraction of the demand to a second source because the buying firm seeks to reduce its risk associated with single sourcing, the original supplier might be less willing to develop new innovations for this customer "because of a smaller possibility to amortise the expenses" (Zsidisin & Ritchie, 2008, p. 131). Accordingly, we describe relationship costs as decreased investments of the supplier into innovations for the buying firm. Table 2 offers descriptions of attributes' levels.

Table 2: Attribute level descriptions

Attributes	**Attribute levels**	
	Low	**High**
Response efficacy	This action can, to a **small extent**, reduce potential future losses	This action can, to a **large extent**, reduce potential future losses
Self-efficacy	Leo **doubts** that he will be able to **successfully implement** this action	Leo is **sure** that he will be able to **successfully implement** this action
Direct implementation costs	Direct implementation costs for this action are **comparatively low**	Direct implementation costs for this action are **comparatively high**
Relationship costs	The current microchip supplier will spend **slightly less** money to develop innovations for Eletrox	The current microchip supplier will spend **considerably less** money to develop innovations for Eletrox

2.3.2 Study participants

Data were collected between January and March 2018 by means of a self-administered online survey. In total, 308 professionals with direct experience in supply chain management from Germany, Austria, and Switzerland, were invited to participate. Contact addresses were obtained from a commercial business data provider. The managers received an invitation via email and were randomly assigned to one of the two vulnerability conditions. Of the 308 professionals, 133 completed the DCE, resulting in an effective response rate of 43.2%. On average, participants had almost 15 years of experience in supply chain management (SD = 12.52). The participants were able to choose between a German and English version of the survey. Thirty-three of the 133 participants (26.3%) opted for the English language version. To validate translation

equivalence, the complete experimental material was carefully translated into German by native speakers and then back-translated into English to ensure equivalent meaning (Craig & Douglas, 2005). Each participant responded to nine choice sets (and an additional tenth choice set as a consistency check). The responses of one participant were excluded due to unrealistically short participation duration. Further data were excluded because nine participants consistently chose the same alternative, resulting in a full sample of 1107 observations. Hence, the data set comprises 123 participants (58 of these completed the low-vulnerability condition).

Individual Characteristics. After the choice sets, the participants were asked to respond to several survey items measuring the specific individual characteristics stated in Proposition 3. First, to determine *proactive personality* (M = 5.17, SD = 0.82; coefficient α = 0.83), participants responded to a well-established reflective 10-item scale with a 7-point Likert-type format (Seibert, Crant, & Kraimer, 1999) shown in Table 3. Second, we measured an individual's *risk attitude* (M = 6.57, SD = 2.32) by means of the widely-used single item measure from (Dohmen et al., 2011) which was identified as the "the best all-round predictor of risky behavior" (p. 522). It requires participants to rate their willingness to take risks, in general, on an 11-point rating scale. Third, *control appraisal* (M = 2.32, SD = 1.03; coefficient α = 0.75) was assessed with four reflective items on a rating-scale ranging from 1 (not at all true) to 7 (very true), adapted from S. K. Parker et al. (2006) (see Table 3). Finally, the respondents reported their *experience* (M = 14.49, SD = 12.70) in the field of supply chain management (measured in years). A summary of the measures' descriptive statistics and bivariate correlations is shown in Table 4.

The psychometric properties of the two reflective multi-item scales (proactive personality and control appraisal) were assessed using covariance-based confirmatory factor analysis (CFA). The resulting fit of the measurement model to the data was acceptable (Hair, Black, Babin, Anderson, & Tatham, 2009): $\chi^2(53) = 83.18$ with $p < 0.01$ ($\chi^2/df = 1.57$), CFI = 0.92, TLI = 0.91, SRMR = 0.06, and RMSEA = 0.07 (90% confidence interval CI = [0.04, 0.10]). As shown in Table 3, the factor loadings of all items were statistically significant ($p < 0.001$) and composite reliabilities (0.84 for proactive personality and 0.76 for control appraisal) exceeded the cut-off value of 0.70 (Hair et al., 2009). The average variance extracted (AVE) values were slightly below (0.37 for proactive personality) and above (0.52 for control appraisal) the common threshold of 0.50.

Table 3: Multi-item measurement scales

Measures and associated indicators		Coefficient alpha	Composite reliability	λ[a]	*SE*
Proactive personality (Seibert et al., 1999)		0.83	0.84		
Please indicate to which extent you agree with the following statements (1: strongly disagree – 7: strongly agree)					
PP1[b]	I am constantly on the lookout for new ways to improve my life.			-	-
PP2	Wherever I have been, I have been a powerful force for constructive change.			0.81	0.05
PP3	Nothing is more exciting than seeing my ideas turn into reality.			0.64	0.06
PP4	If I see something I don't like, I fix it.			0.53	0.07
PP5	No matter what the odds, if I believe in something I will make it happen.			0.52	0.08
PP6	I love being a champion for my ideas, even against others' opposition.			0.67	0.06
PP7	I excel at identifying opportunities.			0.56	0.07
PP8	I am always looking for better ways to do things.			0.47	0.08
PP9	If I believe in an idea, no obstacle will prevent me from making it happen.			0.63	0.07
PP10	I can spot a good opportunity long before others can.			0.55	0.07
Control appraisal (S. K. Parker et al., 2006)		0.75	0.76		
Please indicate to which extent you consider the following statements true (1: not at all true – 7: very true)					
CA1[b]	In my job, most of the problems that I experience are completely "out of my hands."			-	-
CA2	With many of the problems I experience, it is not worth telling anybody because nothing will change.			0.60	0.08
CA3	I feel powerless to control the outcomes of the process I work on.			0.91	0.08
CA4	The same problems keep happening again and again, regardless of what I do.			0.62	0.08

Note. λ refers to standardized factor loading and *SE* to standard error (asymptotically robust estimate).
[a] All factor loadings are significant at the $p < 0.001$ level (two-tailed).
[b] Item was excluded to increase internal consistency.

Table 4: Bivariate correlations and descriptive statistics

	(1)	(2)	(3)	(4)
(1) Proactive personality	**0.37**	*0.12*	*0.02*	*0.00*
(2) Risk attitude	0.35 ***	–	*0.00*	*0.00*
(3) Control appraisal	–0.13	–0.03	**0.52**	*0.04*
(4) Experience (in years)	–0.07	0.02	–0.19 *	–
Mean (*M*)	5.17	6.57	2.32	14.49
Standard deviation (*SD*)	0.82	2.32	1.03	12.70

Note. $n = 121$. Pearson product-moment correlation coefficients are shown below the diagonal, diagonal values represent average variances extracted (where appropriate), and squared correlations (shared variance) are above the diagonal in italics.
* $p < 0.05$ (equals $|r| > 0.18$), ** $p < 0.01$ (equals $|r| > 0.23$), *** $p < 0.001$ (equals $|r| > 0.30$) (two-tailed).

Based on the composite reliability value of proactive personality, it can be concluded that convergent validity of the construct is adequate even though AVE is below 0.50. Moreover, since both constructs extract more variance than they share (Pearson correlation coefficient $r = –0.13$; $r^2 = 0.02$), discriminant validity is supported (Fornell &

Larcker, 1981). Having established the validity and reliability of the reflective scales, we used scale averages as latent variable scores for the following analyses.

Consistency checks. A consistency check choice set, where one of the two proposed proactive actions was a dominant option (all attribute levels were more desirable), was used to assess participants' understanding of the DCE task. Consistent participants chose either the dominant option or the "neither" alternative. Only two of the remaining 123 respondents (1.5 %) failed this consistency check. Data from these respondents were excluded, reducing the sample to 1089 observations (121 included participants × 9 choice sets) for further analyses.

Before analyzing the respondents' choice behavior, the manipulations of vulnerability and severity in the description of the situational context were verified. To this end, all respondents were required to answer two manipulation check questions (7-point rating scales anchored at 1 := "not at all" and 7 := "completely") after reading the scenario description. To validate the manipulation of vulnerability, participants had to evaluate whether the vulnerability to the potential disruption of the protagonist's firm was high. The participants' responses were significantly different for low and high levels of vulnerability (M_{low} = 3.02, M_{high} = 5.80; $t(121)$, $p < 0.001$). Perceived severity was assessed by asking the participants to which extent they agree that the negative consequences of the depicted supply disruption would be severe for the firm of the protagonist. The average response of 5.93 (SD = 1.79) indicated that the participants were well aware of the potential severe damage that a future disruption could cause.

2.4 Results

2.4.1 Estimation strategy

Discrete choice analysis uses random utility theory to provide insights into the choice preferences of individuals (Thurstone, 1927). The main premise of random utility theory is that a decision maker's utility for a certain response option is determined by an explainable systematic component and an unexplainable random component. The former comprises observed attributes of different choice alternatives and individual characteristics of a decision maker (Ben-Akiva & Lerman, 1985; McFadden, 1986), while the latter accounts for all unidentified factors of a decision task (Louviere, Flynn, & Carson, 2010). The characteristics of a decision maker are constant for each individual;

hence, they are typically considered as interaction terms with attributes or alternative-specific constants in estimation models (Ryan, Gerard, & Amaya-Amaya, 2007).

The most widely applied model to analyze and statistically test data from DCEs is the multinomial logit (MNL) model (also known as conditional logit model). MNL relies on the assumption that the random errors in the utility functions of individuals are independent and identically distributed according to Gumbel distribution. Formally, utility is defined as:

$$U_{in} = V_{in} + \varepsilon_{in}. \quad (1)$$

U_{in} is the utility of individual n for choice alternative i, V_{in} is the explainable component, and ε_{in} is the unexplainable random component.

DCEs typically expose participants to choice situations with at least two response options. The alternatives contained in each choice set are constructed by means of a set of attributes. MNL determines the probability of selecting a specific alternative from a set of multiple alternatives as follows (Ben-Akiva & Lerman, 1985; Louviere & Woodworth, 1983; McFadden, 1986):

$$P_{ij} = \frac{e^{V_{ij}}}{\sum_{k=1}^{K} e^{V_{kj}}} \quad (2)$$

where P_{ij} is the probability of choosing alternative i from choice set j out of a total number of K possible alternatives. V_{ij} is the explainable part of an individual's utility function for alternative i in choice set j. This systematic utility component can be expressed as a function of attributes and characteristics of individual decision makers (Lancsar & Louviere, 2008):

$$V_{ij} = \beta X'_{ijl} + \gamma Z'_i \quad (3)$$

with X'_{ijl} being the vector of attributes and their specific levels l of alternative j for individual i and Z'_i the vector of an individual's characteristics. β and γ are the coefficient vectors to be estimated, typically by means of maximum likelihood estimation (Verma & Pullman, 1998).

To analyze our DCE, we distinguish between two proactive actions (*proactive action A* and *proactive action B*) and a "no choice" option. Accordingly, we use the following specification of V_A, V_B, and V_{no} as the probability of choosing proactive action A, proactive action B, or "no choice":

$$V_A = \beta_{ASC} + \beta_{REFF}REFF + \beta_{SEFF}SEFF + \beta_{DICO}DICO + \beta_{RECO}RECO + \beta_{DICO\times VULN}DICO \times VULN + \beta_{RECO\times VULN}RECO \times VULN \quad (4)$$

$$V_B = \beta_{REFF}REFF + \beta_{SEFF}SEFF + \beta_{DICO}DICO + \beta_{RECO}RECO + \beta_{DICO\times VULN}DICO \times VULN + \beta_{RECO\times VULN}RECO \times VULN \quad (5)$$

$$V_{no} = \beta_{nochoice} \quad (6)$$

where β_{ASC} captures alternative-specific effects of proactive action A compared to B, and β_{REFF}, β_{SEFF}, β_{DICO}, as well as β_{RECO} are the coefficients for response efficacy (*REFF*), self-efficacy (*SEFF*), direct implementation costs (*DICO*), and relationship costs (*RECO*). $\beta_{DICO\times VULN}$ and $\beta_{RECO\times VULN}$ are the coefficients of the suggested interactions between response costs (*DICO* and *RECO*) and the scenario variable vulnerability (*VULN*). $\beta_{nochoice}$ reflects the utility associated with the "no choice" option. To investigate Propositions 3a-3d, we added 16 interaction terms between all proactive action attributes (*REFF*, *SEFF*, *DICO*, and *RECO*) and individual-specific factors, namely proactive personality, risk attitude, control appraisal, and experience, to V_A and V_B. For the sake of clarity and due to space constraints, we do not show the augmented equations.

If a "no choice" is offered to participants in a DCE, it has been recommended to consider the use of nested logit (NL) models (Ryan & Skåtun, 2004). To assess whether a nested logit outperforms the MNL model formulation, we constructed a NL model that we compared with the MNL model as delineated above. The NL model comprised the "no choice" option as one (degenerate) nest and the two proactive response options as a second nest. A likelihood ratio test revealed that a nested structure does not significantly improve model fit ($\chi^2(9) = 7.43$; $p = 0.59$). Hence, the MNL model specification was chosen.

2.4.2 Model estimation

Table 5 shows the results of the estimated MNL models as specified in equations 4, 5, and 6. Model 1 serves as a baseline model, which contains only four proactive action attributes that were incorporated in the discrete choice task and the interactions of response cost and vulnerability, as described in Proposition 2. In a second step, we incorporated the individual-specific factors assumed to influence choice behavior as proposed in Propositions 3a-3d into a second model (Model 2). Log likelihood ratio tests

support the statistical significance of Model 1 ($\chi^2(6) = 230.75$; $p < 0.001$) and Model 2 ($\chi^2(22) = 275.92$; $p < 0.001$) and a likelihood ratio test between both models reveals significant improvements from Model 1 to Model 2 ($\chi^2(16) = 45.18$; $p < 0.001$). Hence, detailed results of Model 2 are discussed below.

Table 5: Estimated MNL models

		Model 1			Model 2		
Variable	**Prop.**	***β***	***SE***	***p*-value**	***β***	***SE***	***p*-value**
Utility from specific proactive action attributes							
Alternative-specific constant		0.16	0.11	0.13	0.18	0.11	0.11
Response efficacy	*P1*	1.36	0.12	0.00 ***	1.38	0.12	0.00 ***
Self-efficacy		1.55	0.14	0.00 ***	1.60	0.14	0.00 ***
Direct implementation costs		–1.93	0.35	0.00 ***	–1.94	0.35	0.00 ***
Relationship costs		–1.79	0.29	0.00 ***	–1.71	0.30	0.00 ***
Direct implementation costs × Vulnerability	*P2*	0.48	0.19	0.01 *	0.45	0.20	0.02 *
Relationship costs × Vulnerability		0.48	0.16	0.00 **	0.39	0.16	0.02 *
Response efficacy × Proactive personality	*P3*				–0.33	0.12	0.01 **
Self-efficacy × Proactive personality					–0.15	0.13	0.25
Direct implementation costs × Proactive personality					0.29	0.14	0.05 *
Relationship costs × Proactive personality					0.09	0.14	0.53
Response efficacy × Risk attitude					0.20	0.12	0.09 †
Self-efficacy × Risk attitude					0.01	0.13	0.92
Direct implementation costs × Risk attitude					–0.05	0.14	0.72
Relationship costs × Risk attitude					0.14	0.14	0.31
Response efficacy × Control appraisal					–0.10	0.11	0.36
Self-efficacy × Control appraisal					–0.09	0.12	0.47
Direct implementation costs × Control appraisal					0.26	0.13	0.06 †
Relationship costs × Control appraisal					0.33	0.13	0.01 **
Response efficacy × Experience					–0.20	0.11	0.07 †
Self-efficacy × Experience					–0.05	0.13	0.71
Direct implementation costs × Experience					–0.14	0.14	0.32
Relationship costs × Experience					0.14	0.13	0.30
Utility from not taking proactive action							
Constant		1.31	0.13	0.00 ***	1.33	0.13	0.00 ***
Log likelihood				–998.09 ***			–975.50 ***
Akaike information criterion (AIC)				2012.20			1999.00
McFadden's Pseudo R^2				0.10			0.12

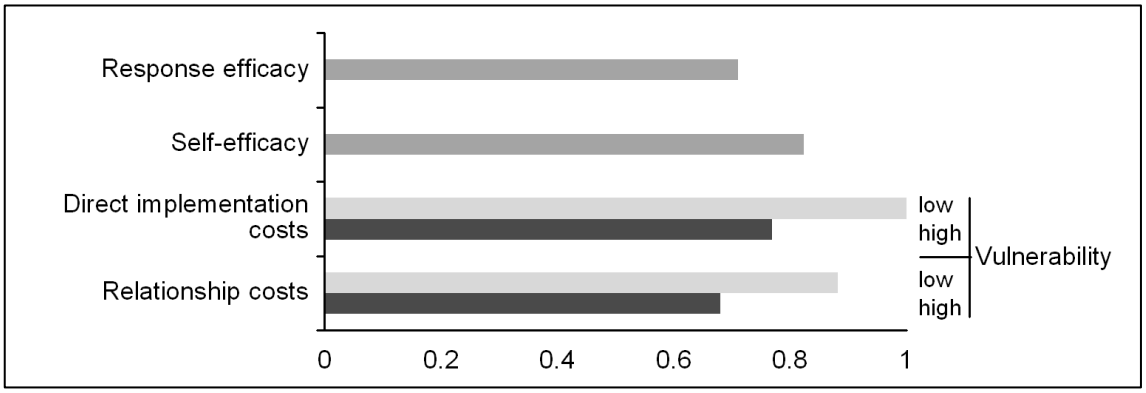
Note. Prop. refers to proposition, *β* to estimated coefficients, and *SE* to standard error. Both models were estimated in NLOGIT 6 using full information maximum likelihood estimators based on 1089 observations (121 participants × 9 choice sets). The variables proactive personality, risk attitude, control appraisal, and experience have been standardized to facilitate the interpretation of the estimated effects. † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (two-tailed).

As a robustness check, a further MNL model was estimated that specifically controlled for effects of the selected language (English/ German) on the relative

importance of proactive action attributes. Although results slightly changed quantitatively, interpretations remained qualitatively similar to those reported in Table 5.

Coping Appraisal Variables. All the attributes used to construct proactive response options (response efficacy, self-efficacy, direct implementation costs, and relationship costs) showed a statistically significant effect on the decision between different types of proactive actions. This lends empirical support for Propositions 1a, 1b, and 1c. As suggested by PMT, response efficacy (β_{REFF} = 1.38, $p < 0.001$) and self-efficacy (β_{SEFF} = 1.60, $p < 0.001$) increase the probability of selecting a specific alternative, whereas direct implementation costs (β_{DICO} = –1.94, $p < 0.001$) and relationship costs (β_{RECO} = –1.71, $p < 0.001$) reduce the latter. The constant term in equation 4 captured alternative-specific effects of proactive action A compared to proactive action B and did not show a statistically significant effect on choice behavior (β_{ASC} = 0.18, $p = 0.11$) which strengthens the validity of the chosen experimental design, because a generic label was used for both of these response alternatives. The relative influence of specific components of the employed model is depicted in Figure 3. Following Verma et al. (2006), we set the most influential β-coefficient (i.e., direct implementation costs) equal to 1 and rescaled all remaining coefficients relative to it between 0 and 1.

Figure 3: Relative importance of DCE response alternative variables



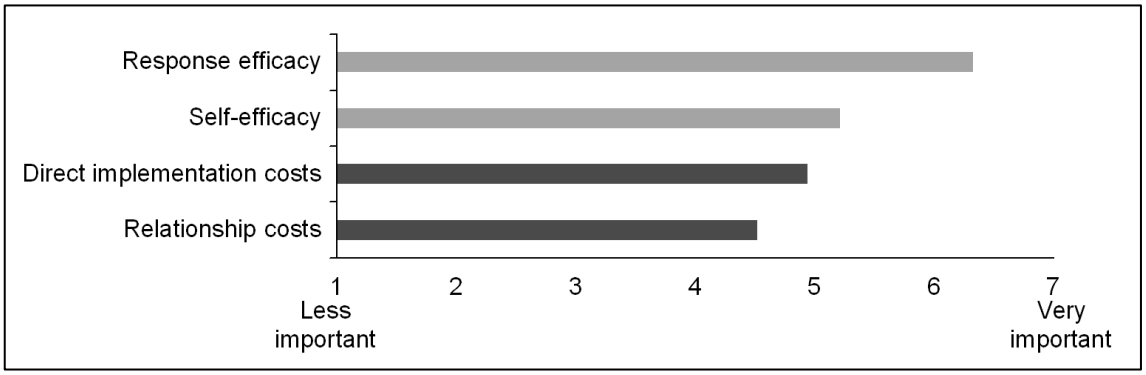
Note. The highest coefficient (direct implementation costs) is set to 1. All other coefficients are rescaled accordingly.

Individual Characteristics. The MNL also allowed for an analysis of further components that are assumed to affect an individual's intention to take proactive action. All four included decision maker characteristics revealed (marginally) significant interaction effects with the relative importance of certain proactive action attributes, providing support for Propositions 3a-3d. The higher an individual's proactive personality, the lower the importance of response efficacy ($\beta_{REFF \times PP}$ = –0.33, $p = 0.01$)

and direct implementation costs ($\beta_{DICO \times PP}$ = 0.29, p = 0.04) for the decision whether to engage in proactive action. Moreover, for more risk-seeking participants, the relative importance of response efficacy increased ($\beta_{REFF \times RISK}$ = 0.20, p = 0.09). Finally, control appraisal reduced the impact of response costs ($\beta_{DICO \times CA}$ = 0.26, p = 0.06; $\beta_{RECO \times CA}$ = 0.33, p = 0.01) on the choice of proactive action alternatives and higher experience resulted in a lower relative importance of response efficacy ($\beta_{REFF \times EXP}$ = –0.20, p = 0.07).

In addition, after participating in the DCE, the respondents were asked to directly rate the perceived relative importance of the four selected proactive action attributes. The results revealed that, in contrast to results of the DCE, the most influential attribute was perceived to be response efficacy (M = 6.33, SD = 0.77) followed by self-efficacy (M = 5.21, SD = 1.32). Direct implementation costs (M = 4.94, SD = 1.34) and relationship costs (M = 4.52, SD = 1.46) were perceived as less important, as shown in Figure 4.[5]

Figure 4: Perceived relative importance of DCE response alternative variables



Vulnerability and Response Costs. As suggested in the second proposition, in addition to the main effects of the coping appraisal variables, vulnerability affected the relative importance of response costs in the selection of alternative proactive actions. When vulnerability is high, direct implementation costs ($\beta_{DICO \times VULN}$ = 0.45, p = 0.02) and relationship costs ($\beta_{RECO \times VULN}$ = 0.39, p = 0.02) of proactive response options are less important for the choice of a specific proactive action.

[5] Pairwise comparisons revealed that, except for the mean difference between the relative importance of self-efficacy and direct implementation costs (p = 0.14), all mean differences were statistically significant (p < 0.05).

2.5 Discussion

2.5.1 Theoretical implications

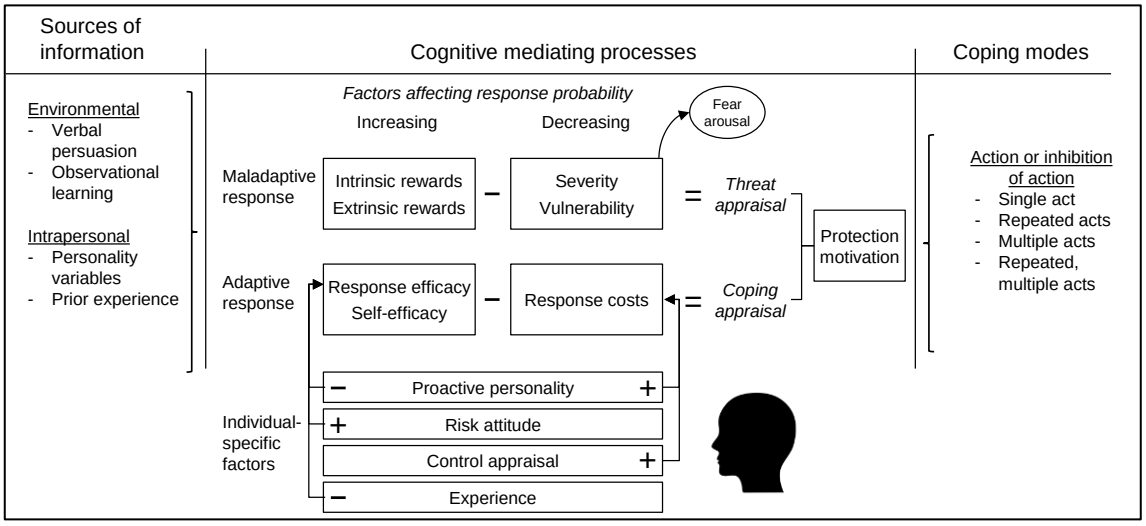
This study has several important theoretical implications for decision making in the context of supply risks and disruptions. First, PMT has primarily been applied to health-related threats that directly concern an individual. This research supports the idea that PMT is more widely applicable and an insightful framework for situations involving almost any kind of threat. Instead of using a threat to individuals that would involve direct emotional or physical harm, we applied PMT to investigate choice behavior of individuals facing a threat to an organization. As per our propositions, the DCE revealed that trade-offs are made in supply risk management to select the most attractive proactive measures. All main variables of PMT's coping appraisal showed statistically significant effects on the participants' choice behavior. The estimated utility that individuals obtain from evaluating the supply disruption scenario and potential proactive measures is an indicator of their protection motivation.

As shown in Figure 3, the most important variables when selecting proactive measures in supply risk management are the two types of response costs variables. High direct implementation or relationship costs can render a proactive measure so unappealing that even high response efficacy or high self-efficacy alone cannot offset this burden. The DCE results, nevertheless, emphasize that self-efficacy is a crucial component that affects the behavior of individuals within organizations, as delineated by prior research (Bandura, 1977). Most surprisingly, the perceived effectiveness of a response alternative in mitigating future loss, which is the main aim of implementing proactive measures, has the lowest relative importance among the included attributes. Finally, although "doing nothing" might appear socially undesirable at first sight, the "no choice" option was the preferred choice in 51.2% of all 1089 choice sets in the final sample.

Second, the role of individual characteristics in the DCE and subsequent analyses demonstrate that there is a need to account for the role of individuals within decision making processes in supply chain risk management. Figure 5 shows an enriched version of PMT, which includes an additional layer depicting the identified interactions of coping appraisals with individual-specific characteristics as a more comprehensive model of proactive behavior.

Proactive personality, risk attitude, control appraisal, and experience had statistically significant effects on the relative importance of certain proactive action attributes. Moreover, the results of this study imply that the components of PMT differ regarding their relative importance. Figure 3 shows that a surprising result of the DCE is that both types of response costs emerged as more decisive variables in determining whether to proactively mitigate future losses than, for instance, the response efficacy of a specific action.

Figure 5: Enriched model of protection motivation theory



Third, the insights generated reveal that the perception of decision makers about the relative importance of certain attributes of a proactive action deviates considerably from their actual choice behavior. For instance, although our participants perceived a proactive action's effectiveness as most decisive for their choice, they subconsciously assigned considerably less importance to it when actually selecting an action. This is an important issue, which could be the result of an overly strong focus on costs that supply chain professionals are not aware of. Our study is, to the best of our knowledge, among the first efforts to empirically identify mismatches between perceptions and actual behavior of professionals in the context of procurement and underlines the need for decision makers to better understand their own choice behavior.

Fourth, the DCE data revealed that the characteristics of a threat affect the relative importance of specific attributes of response alternatives. The effect of direct implementation costs on the behavior of individuals depends on the vulnerability to a threat. As can be inferred from Figure 3, direct implementation costs have a smaller impact on the selection of specific proactive measures in scenarios where the vulnerability

to a threat is high rather than low. This is intuitive in the sense that greater vulnerability might lead to a greater tolerance for higher response costs because, in this case, a threat arising from a supply disruption could appear more unavoidable.

2.5.2 Managerial implications

In addition to the delineated theoretical implications, this study's findings entail considerable implications for managerial practice. One implication of this study is the way in which individuals process insights from observing competitors exposed to supply disruptions to adjust their own management of supply risk. Prior research has already suggested that vicarious learning is a relevant issue in the management of supply risk and disruptions (Hora & Klassen, 2013). We contribute to these insights by adding new details on how exactly information on someone else's misfortune and an impending disruption can be translated into proactive action.

Individual managers focus on the costs of a specific action when they decide whether or not to act proactively, although they perceive self-efficacy and the action's effectiveness as more important. This mismatch between perceptions and actual behavior underlines the need for decision makers to improve their understanding of how they make choices. Moreover, although the DCE focused on the example of a severe disruption that might lead to tremendous (financial) loss, the costs of a measure instead of its ability to mitigate future loss were extremely decisive for individual decision makers. This might reveal a tendency to admit too much relevance to the costs of a response in the selection process of proactive measures which might not always be desirable. The estimated loss associated with a supply disruption is often difficult to discern; this makes it challenging to weigh the costs of a proactive measure against the potential damage.

Finally, in supply risk management, firms depend to a large part on the self-efficacy of their employees (as seen in Figures 3 and 4), which is even more important than the perceived effectiveness of a response option in avoiding the dangers of a threat. Hence, firms benefit from being aware of this circumstance and training their employees to appropriately assess their own abilities and build confidence. Otherwise, a manager who, mistakenly, does not feel capable of successfully performing a certain proactive action will avoid selecting it, which might result in an unnecessarily high exposure to future damage through supply disruptions for a firm. In addition, the results depict several

effects of individual characteristics on proactive behavior. Thus, these insights might be helpful in recruiting decisions and personnel allocation.

2.5.3 Limitations and future research opportunities

Several limitations constrain the contribution of this study, but, at the same time, also highlight fruitful avenues for future research. First and foremost, the choice experiment relies on stated intentions of individuals instead of their real-life behavior. Prior research indicates that intentions can be reliable indicators of actual behavior (Ajzen, 1991; T. L. Webb & Sheeran, 2006). However, in the event of an actual impending supply disruption, individuals might behave differently than indicated in response to the hypothetical choice situation, such as environmental factors or time pressures unaccounted for in our DCE.

Furthermore, the experimental task is limited to decision makers with centralized authority because we assume that this is a basic characteristic of risk management processes. This means that, at the same time, we did not consider many factors that might also influence the selection process of proactive measures, such as the presence of a hierarchy (Mihm, Loch, Wilkinson, & Huberman, 2010), the need to coordinate with others (Lounamaa & March, 1987), or adding other characteristics of an individual manager's work environment (S. K. Parker et al., 2006).

Following previous research, we refrained from explicitly distinguishing response costs and probable extrinsic as well as intrinsic rewards from maladaptive behavior. However, since these rewards are part of the PMT's threat appraisal process, the consideration and implementation of specific rewards of, for example, not taking proactive action within an experimental design might provide an even more sophisticated picture of proactive risk management decisions. In addition, we used four two-level key variables of PMT as attributes to construct response options. As this was the first attempt to model the selection process of proactive actions in supply risk management using discrete choice modelling, this study has an exploratory character and adding attributes or distinguishing among further levels to describe response alternatives in the DCE seems a promising way to generate additional insights.

Another limitation is that choice behavior might vary with the cultural background of respondents as demonstrated by S. C. Schneider and De Meyer (1991). They showed that Latin European managers were more likely to respond proactively to strategic issues than their North American, British, northern European, or Nordic counterparts. Hence, to

make the generated insights more generalizable, we encourage the validation of our results by means of a larger sample comprising supply chain professionals from several cultural regions.

The identification of the main drivers of proactive behavior in supply risk management provides insights into decision making behavior. The results of this study show that PMT is an insightful framework to analyze the selection of proactive measures. Moreover, the identified mismatch between perceptions and actual choice behavior is an interesting topic for future research. The designed DCE can serve as a starting point for future research to further improve our understanding of how managers cope with the threat of supply disruptions and for practitioners to develop training tools for proactive decision making in supply risk management.

Finally, this research focused on supply disruptions that are accompanied by a potentially severe negative impact on the performance of a firm and cannot be solved within day-to-day operations. Choice behavior and the underlying relative importance of specific attributes might considerably diverge between exposure to less severe instead of very severe threats, as already suggested by prior research (Cismaru & Lavack, 2007). It is important to understand the performance implications of these choices when the threat is minor and severe.

Chapter 3 Substantive and symbolic corporate social responsibility: Blessing or curse in case of misconduct?

Co-author:

Christoph Bode
Endowed Chair of Procurement, Business School, University of Mannheim, Germany

Abstract

Often, corporate social responsibility (CSR) is associated solely with "doing good," but firms also have to prevent corporate social irresponsibility (CSIR) (i.e., "avoiding bad"). Many firms engage in CSR – either substantively or only symbolically – in the hopes that a reputation for CSR mitigates negative stakeholder reactions in case the firms suddenly become involved in a CSIR incident. Yet, research on the effects of a CSR reputation on stakeholder reactions to CSIR is equivocal. Some studies have theorized insurance-like effects of ex ante CSR, whereas others have suggested the exact opposite, namely that a reputation for CSR may even aggravate negative reactions to CSIR. Moreover, extant research on stakeholder reactions to CSIR has focused chiefly on consumers and investors, although stakeholders increasingly hold firms accountable for misconduct within their supply chains, which has repercussions on supplier selection decisions. The present study is innovative in that it focuses on the business-to-business (B2B) context from a purchasing perspective and proposes a model that explains the conditions under which CSR acts as an insurance or a liability subsequent to CSIR. The empirical results from a vignette experiment with supply chain managers add to the understanding of the effects of CSR activities on negative stakeholder reactions to CSIR and provide important theoretical and practical implications.

3.1 Introduction

The issue of corporate social irresponsibility (CSIR) has only rarely been addressed in the corporate social responsibility (CSR) literature, although stakeholders devote growing attention to environmental and social misconduct (Fiaschi et al., 2017). Stakeholders exert increased pressure on firms to behave in socially responsible ways (Campbell, 2007) and increasingly hold them responsible for misconduct in their supply chains (Hartmann & Moeller, 2014; Y. H. Kim & Davis, 2016). The academic literature has strongly focused on linking CSR with the concept of "doing good," while "avoiding bad" also constitutes an important condition for firms to be perceived as socially responsible (Lin-Hi & Müller, 2013). CSIR applies to all industries and it can take various forms from environmental disasters (e.g., the Deepwater Horizon oil spill in 2010) and workplace disasters (e.g., the Rana Plaza building collapse in 2013) all the way to corruption and collusion scandals (e.g., the price-fixing cartel of the truck makers DAF, Daimler, Iveco, and Volvo-Renault between 1997 and 2011). The globalization of markets and increasing interconnectedness of supply networks have recently added to the complexity that firms face and made it even more challenging for managers to prevent CSIR. In the light of this development, it is important to understand that consumers not only blame firms for CSIR that occurs inside their own barriers but also hold buying firms responsible for their suppliers' environmental and social misconduct (Hartmann & Moeller, 2014). Subsequent negative stakeholder reactions pose substantial risks that need to be addressed (Lin-Hi & Blumberg, 2018). Since firms are perceived to be only as responsible as their supply network (Andersen & Skjoett-Larsen, 2009), the purchasing function plays a key role in preventing CSIR and addressing these risks. This study focusses on the role of the purchasing function as gatekeeper to CSIR in the supply chain of the focal firm.

Research has been concerned with whether a firm's ex ante CSR activities affect negative stakeholder reactions to CSIR. Most studies have focused on consumer or investor reactions and theorized an insurance-like mechanism of a firm's reputation for CSR, which builds a "reservoir of goodwill" among the firm's stakeholders and mitigates negative responses to bad news (e.g., Flammer, 2013; Godfrey et al., 2009). But there are also studies purporting the exact opposite, namely that firms engaging in CSR experience more negative reactions to CSIR incidents than firms that do not promote themselves as socially responsible (e.g., Sen & Bhattacharya, 2001; Swaen & Vanhamme, 2003; Vanhamme & Grobben, 2009). Indeed, recent examples, such as the German car

manufacturer Volkswagen (VW) that won numerous CSR awards but currently faces severe public criticism due to the "Dieselgate" scandal, cast doubts on insurance-like effects of ex ante CSR (Lynn, 2015).

Like brand commitment or consumer-company identification, a CSR reputation might serve as a goodwill buffer in case of non-severe CSIR, but also an expectation burden in case of severe CSIR (e.g., Einwiller, Fedorikhin, Johnson, & Kamins, 2006; Germann et al., 2014; Janssen et al., 2015; Kang et al., 2016). Based on assimilation-contrast theory, this research contributes to identifying the boundary conditions of the "insurance effect" of a CSR reputation thereby addressing recent calls for more research on how ex ante CSR affects negative stakeholder reactions in the aftermath of CSIR (e.g., Kang et al., 2016; S. Kim & Choi, 2016; Lenz, Wetzel, & Hammerschmidt, 2017). More specifically, this study investigates how negative stakeholder reactions to CSIR in industrial buying contexts are shaped by the type of CSR reputation and the CSIR severity. To this end, the employed research design (randomized vignette experiment) accounts for different approaches to build a CSR reputation (substantive vs. symbolic). The empirical results suggest that CSR mitigates negative reactions to non-severe CSIR but that CSR reputations driven by symbolic actions aggravate negative stakeholder reactions in case of severe CSIR. In addition, the results provide important and innovative insights for managers who are concerned with stakeholder management and the allocation of resources to CSR activities while facing the risk of CSIR.

3.2 Conceptual background and hypotheses development

3.2.1 Substantive and symbolic management of corporate social responsibility expectations

Although the literature on CSR is vast, there are still controversies revolving around the definition of CSR (e.g., Colombo, Guerci, & Miandar, 2017; Sheehy, 2015). As Lin-Hi and Müller (2013) stated, "despite the growing interest in this topic, there is still no general agreement on the precise meaning of CSR" (p. 1928). CSR has often been used as an umbrella term for concepts, such as sustainability, business ethics, or corporate citizenship (de Jong & van der Meer, 2017; Freeman & Hasnaoui, 2011). Nevertheless, the accepted idea of CSR is that society and business are not autonomous but interdependent and that "society has certain expectations for appropriate business behavior and outcomes" (Wood, 1991, p. 695). For the purpose of this study, following

McWilliams and Siegel (2001), we define CSR as a firm's actions that appear to "advance some social good, beyond the interests of the firm and what is required by the law" (p. 117). Moreover, we adopt a holistic, multidimensional view of CSR. Typically, environmental, social, and governance (ESG) activities are captured to determine the degree to which a firm lives up to its CSR (Arvidsson, 2010; Cheng, Ioannou, & Serafeim, 2014). Examples of such activities include the use of renewable raw materials (Ketola, 2010), the establishment of corporate foundations (Westhues & Einwiller, 2006), and the presence of an external auditor to examine, verify, and validate a CSR report (Lynes & Andrachuk, 2008). However, research concerned with CSR has often focused only on single dimensions (e.g., Walls, Berrone, & Phan, 2012) and neglected this multidimensionality (e.g., Bénabou & Tirole, 2010; Carroll, 1979; Waddock & Graves, 1997).

Firms may establish and maintain a reputation for CSR by engaging in CSR-related activities (McWilliams & Siegel, 2001; Vanhamme & Grobben, 2009). More specifically, from a stakeholder perspective, firms have to address their stakeholders' demands, such as customers, suppliers, employees, or local communities, who have expectations with regard to a firm's social responsibility. A firm can obtain support for its operations and, from an institutional perspective, maintain its "social license to operate" (SLO) (Demuijnck & Fasterling, 2016, p. 675) only when the behavior of a firm is in line with these demands. In addition, buying firms are increasingly held responsible for their suppliers' behavior and criticized as soon as this behavior deviates from the stakeholders' expectations (Hartmann & Moeller, 2014). This "chain liability" adds to the challenge of maintaining an SLO, because it implies that a buying firm is only as socially responsible as its supply network (Andersen & Skjoett-Larsen, 2009; Krause, Vachon, & Klassen, 2009). Consequently, the purchasing function plays a key role in implementing a firm's CSR strategy by mitigating risks associated with environmental or social misconduct of suppliers (Hajmohammad & Vachon, 2016; L. Schneider & Wallenburg, 2012).

An SLO provides a basis for firm's activities to be perceived as legitimate in the eyes of stakeholders (Demuijnck & Fasterling, 2016). Legitimacy is typically defined as "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman, 1995, p. 574). According to institutional theory, firms can use two strategies to address their stakeholders' demands and obtain legitimacy. They can pursue

either a *substantive* or a *symbolic* adaptation approach (Ashforth & Gibbs, 1990). From a stakeholder management perspective, the overall aim of these approaches is to manage stakeholders' perceptions of meeting societal expectations by either engaging in actions entailing real change or claims/ promises providing representations of such actions (Wickert, Scherer, & Spence, 2016). Highhouse, Brooks, and Gregarus (2009) developed a model showing that these activities serve as cues about a firm's CSR policy, which are processed by individuals to form a perception about a firm's reputation.

The substantive adaptation approach involves considerable changes in core procedures or long-term investments, which entail certain risks but ensure actual compliance with the expectations imposed by the external environment (Eccles, Ioannou, & Serafeim, 2014). Substantive actions include, for example, the use of renewable energy, the development of products that provide specific health or safety benefits, and the acquisition of an above-average percentage of independent board members. In contrast, the symbolic adaptation approach is based on activities that seek to decouple the firm's actual practices from the external demands by means of superficial actions that merely show "ceremonial conformity" but do not necessarily have any substance (Ashforth & Gibbs, 1990; Meyer & Rowan, 1977). Examples are the formation of a CSR committee, a membership in a voluntary initiative that aims to reduce CO_2 emissions, and the mere claim to provide flexible working hours to employees. These actions do not necessarily entail real and concrete change in business processes, but they have the potential to be utilized as a cover for poor actual CSR performance (Russo & Harrison, 2005). Symbolic responses to stakeholder demands aim at producing "impressions of more material change" (Durand, Hawn, & Ioannou, 2017, p. 5) and managing stakeholder perceptions of environmental and social commitment (Bansal & Clelland, 2004). Despite the circumstance that symbolic activities do not involve concrete changes in organizational procedures, they may suffice to promote a firm's legitimacy because the "appearance rather than the fact of conformity is often presumed to be sufficient for the attainment of legitimacy" (Oliver, 1991, p. 155). In line with this, several empirical studies have suggested that the use of symbolic CSR actions, decoupled from concrete change, positively affects a firm's legitimacy (e.g., Weaver, Trevino, & Cochran, 1999; Westphal & Zajac, 2001; Zott & Huy, 2007). However, although both substantive and symbolic CSR engagement may translate into being perceived as legitimate, further empirical research shows that substantive and symbolic CSR activities may differ with regard to

their implications for stakeholder attributions and behavior (e.g., Donia, Ronen, Sirsly, & Bonaccio, 2017; Godfrey et al., 2009; McShane & Cunningham, 2012; Vlachos, Panagopoulos, & Rapp, 2013).

It is not surprising that, all else equal, managers tend to prefer to pursue the less time-consuming and resource-intensive stakeholder management via symbolic assurances (Ashforth & Gibbs, 1990). This preference for symbolic assurances carries a risk, because stakeholders typically demand substantive action. If noticed, the use of symbols, claims, and promises without actually providing a social good could lead to a loss of all benefits generated from previous CSR activities (Hawn & Ioannou, 2016). If symbolic CSR actions were interpreted as "greenwashing" for the mere sake of being granted legitimacy, firms may be perceived as untrustworthy and manipulative (Walker & Wan, 2012). Being one of the most prominent industry examples of the last decades, British Petroleum's (BP) symbolic commitment to CSR before the Deepwater Horizon catastrophe highlights that such decoupling can be enough to obtain legitimacy. However, this example also highlights that whether substantive or symbolic activities have been chosen to achieve legitimacy has important repercussions in case of severe misconduct because the "beyond petroleum" campaign based on symbolic CSR engagement first helped BP to be perceived as socially responsible, "before being turned against it as a testament of perceived greenwashing" (Matejek & Gössling, 2014, p. 579).

3.2.2 Corporate social irresponsibility

The examination of CSIR in the academic literature started with Armstrong (1977) and the topic has been only rarely addressed since, although "avoiding bad" is considered a precondition for a firm to be perceived as a responsible actor (Lin-Hi & Müller, 2013). In line with Lin-Hi and Müller (2013), we define CSIR as firm-induced incident "that results in (potential) disadvantages and/ or harm to other actors" (p. 1932). This includes, for instance, the release of toxic chemicals into waterways (Greenpeace, 2014), corruption scandals (Clark, 2010), and labor law violations (Reuters, 2014). Such events are frequent and widespread across industries, and the probability of the occurrence of CSIR is a function of the complexity of a firm's business (Vanessa, Jijun, & Bansal, 2006). CSIR incidents may trigger various consequential negative stakeholder reactions such as penalties, compensation payments, sales bans, and decreased employee motivation, but also reputational damage and customer losses, which can even lead to the demise of firms

(e.g., Jin, 2016; Sims & Brinkmann, 2003). To manage the risk of CSIR in their supply chains and curb the chain liability effect, firms can choose from a broad range of actions to respond to misconduct of suppliers. Contractual agreements between a focal firm and its suppliers (e.g., phase-out of a supplier instead of immediate termination of the relationship) might constrain these response actions.

Many firms pursue CSR-related actions in the belief that this protects them from future reputational damage (Janssen et al., 2015; Vanhamme, Swaen, Berens, & Janssen, 2015). Still, several industry examples of CSIR have demonstrated that the effects of a reputation for CSR on stakeholder reactions to irresponsible behavior are more complex than a simple "insurance mechanism" would suggest. VW was highly praised for its strong commitment to CSR until the public was informed that in fall 2015 that the firm cheated on the pollution tests of their diesel vehicles by using an illegally manipulating software. This scandal has already cost VW several billions of U.S. dollars, but the corresponding negative consequences might still not be discernible to the full extent. The firm has been heavily criticized in public, although other car manufacturers were, and still are, exposed to similar accusations (Mehrotra, 2018). Another example concerns the "Deepwater Horizon" oil spill of BP. For years prior to the disaster, BP has spent many resources on its "Beyond Petroleum" campaign to be perceived as a socially responsible firm. Nevertheless, the firm has suffered tremendously from the disaster in 2010. It is argued that a driver of the stakeholder criticism was the firm's CSR engagement prior to the event (Janssen et al., 2015).

Moreover, several published studies obtained results that the "insurance mechanism" is not able to explain. These studies suggest that under certain conditions, mitigating effects resulting from a CSR reputation are fragile, and ex ante CSR engagement may even lead to more negative stakeholder reactions subsequent to CSIR compared to firms that do not have a CSR reputation. For instance, if the domain of the CSIR incident is related to a firm's prior CSR activities, a CSR reputation acts as a liability that aggravates negative reactions (Wagner, Lutz, & Weitz, 2009). The recent study by S. Kim and Choi (2016) complements this finding, demonstrating that the effect of post-crisis communication of CSR activities on negative stakeholder reactions depends on the domain of pre-crisis CSR initiatives conducted by the firm facing the crisis. The domain of a firm's post-crisis CSR engagement is also decisive for its implications on firm value. If the engagement is related to the domain of a firm's CSIR, it is perceived as

insincere while it may enhance firm value if it is related to other domains (Lenz et al., 2017). In addition, it is important to consider the channels through which firms communicate CSR activities prior to CSIR, especially when these activities do not relate to the domain of the CSIR incident. CSR activities that are communicated through highly credible third-party sources augment negative stakeholder reactions while CSR information that is communicated using firm-controlled sources is able to attenuate adverse responses compared to firms that do not at all communicate their CSR activities (Vanhamme et al., 2015). Finally, the results of an experimental study revealed that firms with a brief CSR history may experience more negative stakeholder reactions to corporate crises when they use their CSR engagement in their post-CSIR communication, whereas firms with a long CSR history can benefit from mentioning their involvement (Vanhamme & Grobben, 2009). All these research efforts highlight that insurance-like effects from ex ante CSR cannot be taken for granted.

3.2.3 Assimilation and contrast effects subsequent to CSIR

Previous research has strongly focused on theorizing an insurance-like mechanism of a firm's reputation for CSR in case of misconduct, however, the boundary conditions of insurance-like effects of ex ante CSR on negative stakeholder reactions to CSIR remain unclear. CSR-related activities do not necessarily need to translate into positive effects for a firm, especially if this involvement is perceived as insincere (Sen & Bhattacharya, 2001). When a firm with a reputation for CSR is involved in CSIR, customers can lose their more positive perception and trust this firm less than if it would have not been promoted as socially responsible (Swaen & Vanhamme, 2003).

Assimilation-contrast theory describes how individuals evaluate new information. Its underlying idea is that an individual's initial expectations towards an issue serve as a reference point to which the new information is compared (Hovland, Harvey, & Sherif, 1957; Sherif & Hovland, 1961). Depending on the extent to which the new information violates the initial expectations, the disparity will either be assimilated towards the reference point or contrasted away from it. In line with this, Kang et al. (2016) argued that in a fashion similar to that of brand commitment in case of product recalls (Germann et al., 2014) or consumer-company identification in times of negative publicity (Einwiller et al., 2006), a reputation for CSR might attenuate negative stakeholders' reactions to light, non-severe CSIR but augment negative responses to severe CSIR. Put differently,

stakeholders might respond more negatively to severe CSIR than if they would have not perceived this firm as socially responsible. Based on insights from research on assimilation-contrast theory (e.g., R. E. Anderson, 1973), the framework for understanding the roles of CSR in crisis situations developed by Janssen et al. (2015) suggests that assimilation and contrast effects are not only driven by the characteristics of CSIR (e.g., its severity) but also by stakeholder perceptions of CSR motives. These motives are either extrinsic (akin to symbolic CSR) or intrinsic (akin to substantive CSR). Intrinsically motivated CSR engagement is perceived as acting out of profit-driven self-interest while extrinsically motivated CSR activities are interpreted as genuine concern for environmental and social concerns (Batson, 1998). Assimilation-contrast theory provides valuable insight into how reputations for CSR affect negative stakeholder reactions to CSIR and, more specifically, into the boundary conditions of the insurance-like mechanism of ex ante CSR.

To operationalize the reactions of customers to CSIR, we focus on two important customer outcomes of buying situations, *purchase intention* (PI) and the *intention to engage in negative word-of-mouth* (nWOM) (Maxham & Netemeyer, 2003). They cover two facets of customer behavior, and they are well-established and validated in the B2B marketing literature (Leroi-Werelds, Streukens, Brady, & Swinnen, 2014). Purchase intentions depict how a customer intends to act in a specific buying situation while intentions to engage in nWOM represent customers' behavior after the buying situation. Two unique characteristics distinguish nWOM from purchase intentions, the effect of nWOM tends to last longer and nWOM is a potential source of information (Ham & Kim, 2017). Hence, nWOM can have tremendous consequences and may affect the purchase decisions of not only a supplier's existing, but also potential customers (Ferguson & Johnston, 2011; Money, Gilly, & Graham, 1998). In industrial buying contexts, nWOM could be shared through, for instance, supplier-selected referrals (Hada, Grewal, & Lilien, 2014). Industrial buyers tend to rely on referrals even more than consumers (Wangenheim & Bayón, 2007) and considerable empirical evidence shows that both purchase intention and nWOM are related to actual behavior (E. W. Anderson, Fornell, & Lehmann, 1994; Morgan & Rego, 2006). A joint focus on both variables captures a thorough picture of the behavior of professional buyers.

As an important characteristic of CSIR, the severity of environmental or social misconduct might moderate the link between CSIR and negative stakeholder reactions.

CSIR of low severity could result in assimilation effects if a firm has had a reputation for CSR prior to the incident. In this case, the disparity between a stakeholder's expectations and the firm's true CSR performance might be small enough to be tolerated and assimilated towards the more positive initial perception by stakeholders. Assimilation-contrast theory suggests that these assimilation effects lead to more favorable stakeholder reactions than if a firm would have not positioned itself as socially responsible. In addition, since non-severe CSIR does not fundamentally call into question a firm's reputation for CSR and its corresponding motives (Janssen et al., 2015), both substantive and symbolic CSR are expected to produce these insurance-like effects. Hence, to investigate whether firms with reputations for substantive or symbolic CSR will experience assimilation effects that attenuate negative stakeholder reactions in case of non-severe CSIR, we hypothesize the following:

Hypothesis 1. *If a firm with a reputation for substantive CSR is involved in non-severe CSIR, it experiences smaller negative effects on its customers'*
(a) purchase intention and
(b) intention to engage in negative word-of-mouth
than firms that do not have a reputation for CSR.

Hypothesis 2. *If a firm with a reputation for symbolic CSR is involved in non-severe CSIR, it experiences smaller negative effects on its customers'*
(a) purchase intention and
(b) intention to engage in negative word-of-mouth
than firms that do not have a reputation for CSR.

According to assimilation-contrast theory, thresholds exist for both acceptance and rejection and stakeholders will not accept a further increase in disparity beyond the threshold of acceptance; therefore, severe CSIR that considerably fails to meet a stakeholder's initial expectations based on a firm's ex ante CSR reputation might result in contrast effects. We argue that this might not always be true. In the context of CSR, the effectiveness of a firm's actions used to be perceived as socially responsible can depend on their nature. Previous research has highlighted that substantive and symbolic CSR activities do not necessarily affect stakeholder reactions similarly (e.g., Donia et al., 2017; Hawn & Ioannou, 2012). More specifically, in case of considerable violations of prior expectations, it does matter for stakeholders whether legitimacy was achieved by engaging mainly in symbolic rather than substantive CSR activities (Carlos & Lewis, 2018; Lyon & Maxwell, 2011; Zavyalova, Pfarrer, Reger, & Shapiro, 2012). Symbolic CSR actions can be perceived as an ineffective attempt to meet stakeholder expectations when the disparity between expected and true performance is large. If identified as

extrinsically-motivated greenwashing, symbolic management is likely to be punished (Forehand & Grier, 2003; Janssen et al., 2015).

Accordingly, for severe CSIR incidents, we argue that firms which have established a reputation for CSR driven by symbolic engagement will experience more negative stakeholder reactions compared to firms, which have no CSR reputation (all else being equal). The underlying logic is that the CSIR incident creates a large disparity in the stakeholder expectations formed by a firm's CSR reputation, which leads to contrast effects. Hence, the customer magnifies the perceived disparity between the incident and the initial expectations and reacts even more negatively to the incident than if the firm would have not promoted itself as socially responsible. Prior research has suggested that in visibly polluting industries, CSR engagement can harm corporate financial performance (Walker & Wan, 2012). Strong and clear negative information concerning a CSIR incident puts in doubt the credibility of ex ante CSR engagement and erodes the overall legitimacy of the firm maneuvering a firm in a worse position than if stakeholders had no information about its CSR activities (Yoon, Gürhan-Canli, & Schwarz, 2006).

Firms that have established a CSR reputation based on substantive engagement are likely to experience more favorable blame attributions about crisis responsibility since their CSR motives are perceived to be intrinsically motivated. Extant empirical research highlights that, even in case of severe incidents, stakeholders will be more likely to attribute CSIR to bad luck rather than malevolence or develop alternative explanations if stakeholders believe in intrinsic CSR motives (Godfrey et al., 2009; Minor & Morgan, 2011). Accordingly, we propose:

Hypothesis 3. *If a firm with a reputation for substantive CSR is involved in severe CSIR, it experiences smaller negative effects on its customers'*
(a) purchase intention and
(b) intention to engage in negative word-of-mouth
than firms that do not have a reputation for CSR.

Hypothesis 4. *If a firm with a reputation for symbolic CSR is involved in severe CSIR, it experiences larger negative effects on its customers'*
(a) purchase intention and
(b) intention to engage in negative word-of-mouth
than firms that do not have a reputation for CSR.

3.3 Method

We used a vignette-based experimental approach to test our hypotheses on the effect of a firm's CSR reputation in the aftermath of CSIR in B2B contexts. A vignette is typically

defined as a "short, carefully constructed description of a person, object, or situation, representing a systematic combination of characteristics" (Atzmüller & Steiner, 2010, p. 128). Recently, vignette-experiments have been employed in the operations management context to investigate make-or-buy decisions (Mantel, Tatikonda, & Liao, 2006), observational learning (Hora & Klassen, 2013), and perceptual differences between buyers and suppliers (Ro, Su, & Chen, 2016).

This approach has several methodological advantages. First, vignette-based experiments provide a controlled test of the hypothesized causal relationships by carefully manipulating the vignettes presented to the participants. Second, compared to retrospective surveys or case studies, vignette-based experiments can generate more reliable data, because the participants have to indicate their intentions shortly after reading a specific scenario, which minimizes retrospective bias (Wathne, Biong, & Heide, 2001). Furthermore, given the sensitive nature of environmental and social misconduct, a vignette-based experimental design can minimize social desirability bias (Rungtusanatham et al., 2011; Wason et al., 2002). Third, an experimental design enables researchers to study behavior and choices where individuals or firms are usually not likely to share information (Rungtusanatham et al., 2011). A CSIR incident typically has adverse effects on firms. Moreover, severe incidents are rather rare, and it would be unethical to disrupt a firm to collect data. Vignette-based experiments help overcome both issues.

We used an online experiment to maintain control over experimental conditions, especially since our participants are geographically dispersed. In addition, we integrated vignettes into a survey, as this is a promising but rarely applied approach to study respondents' judgments and account for the shortcomings of each approach (Atzmüller & Steiner, 2010). By randomly assigning participants to treatment conditions, we eliminated systematic differences in the participants that might affect their responses (e.g., Bachrach & Bendoly, 2011). As a result, differences in response behavior can be attributed to the manipulated experimental treatments.

3.3.1 Development of vignettes and experimental design

We carefully constructed vignettes to assign the participants to a scenario in which they served as professional buyers who are considering buying a specific product from a potential supplier. Thereby, a projective technique – a form of indirect questioning from

the perspective of another person or group – was utilized to limit potential demand characteristics and effects of social desirability (Fisher, 1993). In line with the principle of form postponement, all vignettes contained the same introductory paragraph (*common module)* to ensure that all participants are provided with a similar contextual background (Rungtusanatham et al., 2011).

Our factors of interest, CSR reputation and CSIR severity, were manipulated in a subsequent *experimental cues module*. All other factors of the vignettes were held constant. In total, using a 3 (CSR reputation: *None*, *symbolic*, or *substantive*) x 2 (CSIR severity: *Low* or *high*) full factorial design, six vignettes were created. After reading a vignette, the participants were asked to answer questions regarding their intentions and perception of the situation. Table 6 shows the descriptions of the vignette modules.

We manipulated our factors of interest as follows. Information on the CSR reputation of the potential supplier was either not given (*none*), contained several symbolic activities (*symbolic*), or mentioned specific substantive activities (*substantive*). To differentiate between substantive and symbolic activities, we relied on Hawn and Ioannou (2012) and their categorization of 120 Thomson Reuters (ASSET4) items. Accordingly, a CSR reputation driven mainly by *substantive* activities was described by specific policies and quantitative indicators of CSR implementation, whereas claims and reports represented a CSR reputation driven mainly by *symbolic* activities.

Each CSR reputation manipulation contained three specific actions. To capture CSR in a broad sense rather than focusing on one single dimension, each of these actions addressed one of the three CSR dimensions (environment, society, and governance). Additionally, both substantive and symbolic CSR reputations were highlighted by describing that the potential supplier achieved high CSR ratings and that the firms reported on how they either contribute to the general welfare of society (*symbolic*) or implement specific measures to increase the latter (*substantive*).

In line with previous research, CSIR severity was manipulated by varying the effect of and damage caused by a specific event (e.g., Germann et al., 2014; Hartmann & Moeller, 2014). We illustrated the effect or damage associated with a CSIR incident by altering the number of people that were hurt or affected by a leak of ammonia at one of the supplier's facilities. Ammonia leakages frequently occur in practice and vary in terms of the damage caused (e.g., Wong, 2013). We varied CSIR descriptions to distinguish between *low* and *high* severity.

Table 6: Vignette module text descriptions

Introduction	Mr. Müller is a professional buyer for the textile manufacturer TextileCorp. One of his responsibilities concerns buying textile printers which allow for a cost-effective application of color on textiles in specific patterns and designs. Due to difficulties with the former supplier for textile printers, Mr. Müller has been instructed to find and select a new one. He compares and analyzes the product offerings of several potential suppliers and receives corresponding quotations. Based on his analyses, the firm PrintInc is his favorite choice.		
Factor	**Manipulated factor levels**		
CSR reputation	**Substantive**	**Symbolic**	**None**
	PrintInc is well-known for its activities related to corporate social responsibility (CSR) and receives very good CSR ratings. To contribute to the welfare of society, PrintInc has implemented concrete and extensive measures. The firm uses ecological criteria in its supplier selection process, has an above-average share of female supervisory board members, and pursues a clear strategy to improve the work-life-balance of its employees.	PrintInc is well-known for its activities related to corporate social responsibility (CSR) and receives very good CSR ratings. PrintInc reports about its engagement for the welfare of society. The firm publishes a CSR report on an annual basis, is a member of an initiative to reduce CO2 emissions, and claims to strictly control for compliance with human rights inside of its own supply chain.	(–)
CSIR severity	**High**	**Low**	
	After Mr. Müller identified PrintInc as his favorite supplier, it became publicly known that there was an incident at one of PrintInc's factories. Due to insufficient safety precautions, large amounts of ammonia leaked into the air. Six employees died at the scene. 25 other employees, as well as a number of local residents which lived nearby, had to be taken to hospital because of massive respiratory problems and serious cauterization of their airways.	After Mr. Müller identified PrintInc as his favorite supplier, it became publicly known that there was an incident at one of PrintInc's factories. Due to insufficient safety precautions, very small amounts of ammonia leaked into the air. Two employees complained of minor respiratory problems. At no point of time were residents of this area in danger.	

Note. The table shows translations; the original language was German.

As Wason et al. (2002) recommended, the vignettes were pre-tested with 61 students to assess their validity, internal consistency, and realism. The development of two different vignette versions ensured that the distinction between substantive and symbolic CSR was independent of specific semantics or CSR activities and that the CSIR incident selected was realistic. The two vignette versions differed regarding the depicted CSIR incident (version 1: Ammonia leak, version 2: Immoral surveillance of employees) and the delineated CSR activities for substantive and symbolic CSR reputations. The students were randomly assigned to two vignettes (one out of six per vignette version).

After reading a vignette, the students were supposed to indicate their purchase intention (PI) and intention to engage in nWOM.

In addition, the students responded to manipulation check items to ensure that the representations of different levels of CSR reputation and CSIR severity were appropriate. For both vignette versions, the mean responses differed significantly across different levels of our manipulated variables. In the pre-test, the students also rated the degree of realism of the vignettes on a seven-point scale (1 = "not at all" to 7 = "totally"). The results suggested that the scenarios appeared realistic and the six different vignettes of version 1 were perceived as slightly more realistic compared to the vignettes of version 2. The mean responses to the six different vignettes of version 1 ranged from 4.8 to 6.1 (5.6 on average) while the means for those of version 2 ranged from 4.4 to 6.0 (5.2 on average). Consequently, vignette version 1 was selected for data collection. Minor modifications after the pre-test refined the clarity and wording of manipulations.

3.3.2 Study participants

Between March and June 2017, the data were collected by means of a self-administered online experiment. Contact addresses were obtained from a commercial business data provider. The participants of our experiment were full-time working professionals with direct experience in supply chain management working for firms from 15 different industries in Germany, Austria, and Switzerland. The subjects received an invitation via e-mail and they were randomly assigned to one of the six treatment conditions. Out of the 1064 managers invited, 153 managers (16.3% female) completed the experiment, resulting in an effective response rate of 14.4%. Inconsistent participation duration led to the exclusion of five observations. Box plots of the outcome variables showed 13 visible outliers (Tukey, 1977). In line with prior research (Aguinis, Gottfredson, & Joo, 2013; Raaijmakers, Vermeulen, Meeus, & Zietsma, 2015), these were excluded from further analyses resulting in a full sample of 135 usable scenarios. On average, the participants had almost 17 years of experience in supply chain management (*SD* = 10.62).

3.3.3 Measures

We focused on two distinct customer outcomes as dependent variables, *purchase intention* and *intention to engage in nWOM*. The measures described in the following

subsection utilize seven-point rating scales (ranging from 1 := "not at all" to 7 := "totally").

Purchase intention (PI). Purchase decisions are typically binary, as one can either buy or not buy. The use of a binary variable in an experiment, however, results in a dependent variable with little variance to explain. This would considerably limit the ability to understand the effects of our independent variables on the participants' intentions (McKelvie, Haynie, & Gustavsson, 2011). In line with previous research, we therefore operationalized PI as one of our dependent variables measured on a Likert-type scale and asked the participants to indicate how likely they would be to buy the respective product if they were the decision maker described in the scenario (e.g., Sen & Bhattacharya, 2001; Wilcox, Kim, & Sen, 2009). We thereby followed the recommendations to use single-item measures for doubly concrete constructs, such as PI (Bergkvist & Rossiter, 2007). Doubly concrete constructs have both a clear object (e.g., a product) and a single-meaning attribute (e.g., willingness to buy).

Intention to engage in nWOM. As a further dependent variable, we measured the extent to which participants would be willing to engage in nWOM (M = 1.96, SD = 1.23; α = 0.82) after reading a given scenario (Richins, 1983; Singh, 1990). To this end, the participants responded to three items, which we adapted to our vignettes from recent research in the CSR context (Antonetti & Maklan, 2016). The three items reflect an individual's willingness to spread negative information about the specific supplier involved in CSIR.

Given the sensitivity of the investigated topic, and to be able to investigate the influence of personal attitudes towards CSR on the behavior of the participants, we also measured their level of *CSR support* (M = 5.15, SD = 1.12; α = 0.75) using an adapted five-item scale at the end of the experiment (e.g., Ramasamy, Yeung, & Au, 2010). The participants had to indicate the degree to which they were (1) willing to pay more to buy products from a socially responsible firm, (2) considering the ethical reputation of business when they shop, (3) avoiding to buy products from firms that have engaged in immoral actions, (4) willing to pay more to buy products of a company that shows engagement for the well-being of our society, and (5) willing to rather buy from a firm with a socially responsible reputation, if the price and quality of two products are similar. Finally, the respondents provided standard demographic information (gender), firm

related information (industry), and their experience in the field of supply chain management (in years).

The psychometric properties of the two reflective scales (nWOM and CSR support) were assessed using a covariance-based confirmatory factor analysis (CFA). The measurement model resulted in an acceptable fit to the data, given the relatively small sample size (Hair et al., 2009): $\chi^2(19) = 45.76$ with $p = 0.001$ ($\chi^2/df = 2.41$), CFI= 0.94, TLI = 0.91, SRMR = 0.083, and RMSEA = 0.102 (90% confidence interval *CI* = [0.065, 0.140]). Moreover, all items showed large and statistically significant factor loadings on their hypothesized factor ($p < 0.05$ for all loadings). Composite reliability for both constructs (0.86 for nWOM and 0.75 for CSR support) exceeded the cut-off value of 0.70. The average variance extracted (AVE) values were 0.67 for nWOM and 0.42 for CSR support; thus, above or slightly below the 0.5-threshold. Since both constructs extracted more variance than they share with each other (Pearson correlation coefficient $r = –0.10$; $r^2 = 0.01$), discriminant validity was supported. Given these results, the following analyses use scale averages.

3.3.4 Manipulation checks

As in the pre-test, we verified that our manipulations of the independent variables worked as intended. To this end, all participants responded to several manipulation check questions after reading a vignette. The item for CSIR severity asked participants to rate whether the incident was very severe or not on a seven-point Likert-type scale. The respondents' perception of CSIR severity was significantly lower for vignettes that described a CSIR incident with low severity than for vignettes containing a description of a CSIR incident of high severity ($M_{low} = 3.92$, $M_{high} = 6.58$; $t(133)$, $p < 0.001$). Another item asked the participants whether they had received information on the supplier's CSR reputation before the CSIR incident happened. Almost 84% of the participants who had received information on CSR correctly responded to this question. If a respondent answered this question with yes, another item appeared on the screen, which specifically asked for the perceived nature of the CSR reputation on a seven-point scale (1 := "mainly symbolic" to 7 := "mainly substantive"). To ensure that all participants had the same information on how to distinguish substantive from symbolic CSR activities, we provided a brief explanation to delineate that substantive CSR does involve *concrete change of business practices* while symbolic CSR does not. The participants' responses were

significantly different for substantive and symbolic CSR reputations ($M_{symbolic}$ = 3.97, $M_{substantive}$ = 4.77; $t(65)$, p = 0.04).

3.4 Results

To test our hypotheses, we relied on analysis of variance (ANOVA). Parametric tests (e.g., ANOVA) are appropriate and robust for rating-scale data, and they can be used with "small sample sizes, with unequal variances, and with non-normal distributions, with no fear of 'coming to the wrong conclusion'" (Norman, 2010, p. 631). We conducted two two-way ANOVAs with CSR reputation (none, symbolic, or substantive) and CSIR severity (low or high) as between-subjects factors. Table 7 shows the number of participants per cell, the cell means, the corresponding standard deviations for both of our dependent variables PI and nWOM, and the correlation between our dependent variables. Table 8 and Table 9 show the results of the two ANOVAs.

Table 7: Frequencies, cell means, standard distributions, and correlation for the dependent variables

Experimental condition		**Purchase intention (*PI*)**		**Negative word-of-mouth (*nWOM*)**		**Number of observations** (n = 135)	**Correlation of *PI* and *nWOM*** ($r_{overall}$ = –0.48)
CSIR severity	**CSR reputation**	***M***	***SD***	***M***	***SD***		
Low	None	4.52	1.97	2.06	0.96	23	–0.28
	Symbolic	6.47	0.62	1.10	0.16	17	–0.50
	Substantive	5.73	0.94	1.33	0.43	22	–0.16
High	None	3.21	2.09	2.21	1.25	33	–0.35
	Symbolic	3.33	2.13	2.84	1.90	21	–0.47
	Substantive	3.58	2.14	1.96	1.00	19	–0.27

Table 8: ANOVA results with purchase intention (*PI*) as dependent variable

Source	**Partial *SS***	***df***	***MS***	***F***	***p*-value**
CSR reputation	27.49	2	13.74	4.19	0.017 *
CSI severity	156.29	1	156.29	47.65	0.000 ***
CSR reputation × CSI severity	18.59	2	9.30	2.83	0.062 †
Model	194.51	5	38.90	0.62	0.000 ***
Residual	423.15	129	3.28		

Note. SS refers to "sum of squares", *df* to "degrees of freedom", and *MS* to "mean square"; n = 135.
† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

PI was the dependent variable in the first ANOVA. The results revealed an only marginally statistically significant interaction effect between CSR reputation and CSIR severity (F = 2.83, p = 0.06). The main effects of CSR reputation (F = 4.19, p = 0.02)

and CSIR severity ($F = 47.65$, $p < 0.001$) were statistically significantly different from zero, but are qualified by the interaction effect; hence, we do not dwell on them.

Table 9: ANOVA results with intention to engage in negative word-of-mouth (nWOM) as dependent variable

Source	Partial *SS*	*df*	*MS*	*F*	*p*-value
CSR reputation	5.55	2	2.77	2.18	0.118
CSI severity	22.98	1	22.98	18.03	0.000 ***
CSR reputation × CSI severity	14.22	2	7.11	5.58	0.005 **
Model	39.89	5	7.98	6.26	0.000 ***
Residual	164.39	129	1.27		

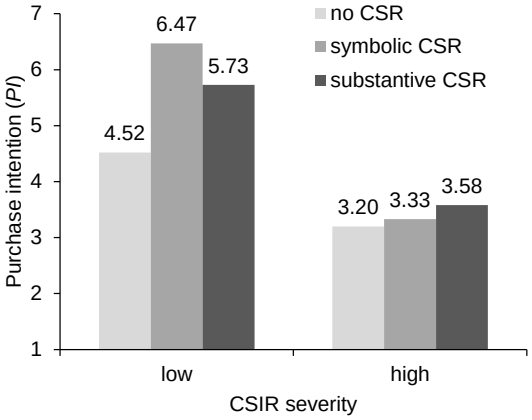
Note. SS refers to "sum of squares", *df* to "degrees of freedom", and *MS* to "mean square"; $n = 135$.
† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Planned contrast analysis revealed that when CSIR severity was low, PI was higher for substantive and symbolic CSR reputations than for no CSR reputation ($M_{\text{substantive, low}} = 5.73$, $M_{\text{symbolic, low}} = 6.47$, $M_{\text{none, low}} = 4.52$; *p's* < 0.05), supporting Hypotheses 1a and 2a. Furthermore, when CSIR severity was high, the effect of PI was not significantly different from zero across different CSR reputation types ($M_{\text{substantive, high}} = 3.58$, $M_{\text{symbolic, high}} = 3.33$, $M_{\text{none, high}} = 3.21$; *p's* > 0.05), providing no support for Hypothesis 3a. Hypothesis 4a, which proposed that symbolic CSR aggravates negative reactions to severe CSIR, was also not supported.

The second ANOVA used nWOM as the dependent variable. Similarly, the results revealed a strong and statistically significant interaction between CSR reputation and CSIR severity ($F = 5.58$, $p = 0.005$). The main effect of CSIR severity ($F = 18.03$, $p < 0.001$), which was qualified by the mentioned interaction effect, was also statistically significantly different from zero. Planned contrasts examined differences between specific groups. In line with Hypotheses 1b and 2b, when CSIR severity was low, nWOM was significantly lower for substantive and symbolic CSR than for no CSR ($M_{\text{substantive, low}} = 1.33$, $M_{\text{symbolic, low}} = 1.10$, $M_{\text{none, low}} = 2.06$; *p's* < 0.05). When CSIR severity was high, nWOM was not significantly different between the substantive and no CSR conditions ($M_{\text{substantive, high}} = 1.96$, $M_{\text{none, high}} = 2.21$; $p = 0.45$). This is inconsistent with Hypothesis 3b. Finally, as predicted in Hypothesis 4b, nWOM was significantly higher for symbolic CSR than for no CSR ($M_{\text{symbolic, high}} = 2.84$, $M_{\text{none, high}} = 2.21$; $p = 0.05$). Figures 6a and 6b depict the two interaction effects, and Table 10 provides a summary of our tested hypotheses.

Figure 6: Interaction effect of CSR reputation and CSIR severity

(a) Purchase intention (*PI*) as dependent variable



(b) Intention to engage in negative word-of-mouth (*nWOM*) as dependent variable

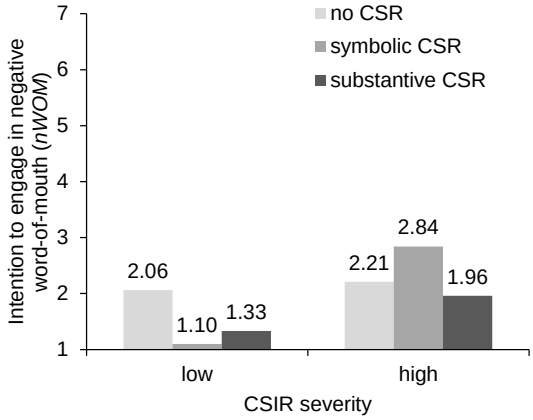


Table 10: Summary of hypotheses and results

Hypothesis	Prediction	Result
	If a firm with a reputation for substantive CSR is involved in non-severe CSIR, it experiences smaller negative effects on its customers'	
H1	*(a) purchase intention*	*Supported*
	(b) intention to engage in negative word-of-mouth	*Supported*
	than firms that do not have a reputation for CSR.	
	If a firm with a reputation for symbolic CSR is involved in non-severe CSIR, it experiences smaller negative effects on its customers'	
H2	*(a) purchase intention*	*Supported*
	(b) intention to engage in negative word-of-mouth	*Supported*
	than firms that do not have a reputation for CSR.	
	If a firm with a reputation for substantive CSR is involved in severe CSIR, it experiences smaller negative effects on its customers'	
H3	*(a) purchase intention*	*Not supported*
	(b) intention to engage in negative word-of-mouth	*Not supported*
	than firms that do not have a reputation for CSR.	
	If a firm with a reputation for symbolic CSR is involved in severe CSIR, it experiences larger negative effects on its customers'	
H4	*(a) purchase intention*	*Not supported*
	(b) intention to engage in negative word-of-mouth	*Supported*
	than firms that do not have a reputation for CSR.	

To examine the robustness of our findings and to ensure that the participants' intentions were not determined by their level of CSR support and experience, we included both variables as covariates in separate analyses of covariance (ANCOVA) with PI and nWOM as dependent variables and CSR reputation as well as CSIR severity as independent variables. Neither the level of CSR support nor the work experience in

supply chain management of the participants had a statistically significant influence on the dependent variables. Hence, the predicted effects remained qualitatively similar.

3.5 Discussion

In the academic literature, the topic of CSIR has rarely been addressed, although "avoiding bad" constitutes a precondition for firms to be perceived as socially responsible. The recurrent examples of firms that are involved in CSIR prove that it is a challenging task to prevent environmental and social misconduct. Subsequent negative stakeholder reactions may severely damage a firm's performance and reputation; thus, responsible managers need to address them. Many firms believe that their ex ante CSR engagement may provide insurance-like effects, which attenuate negative effects of CSIR. Several research efforts have supported this idea. However, we demonstrated that a firm's reputation for CSR plays a more complex role in managing stakeholder reactions to CSIR. Thereby, we contribute to the literature on CSR, CSIR, and disruption management by (1) providing insights into the moderating effects of ex ante CSR reputations in case of CSIR, (2) demonstrating that the insurance-like or aggravating effects of prior CSR reputations are determined by the reputation's nature (substantive/ symbolic) and the severity of CSIR, and (3) improving our understanding of managing CSR and CSIR in buyer-supplier relationships.

3.5.1 Theoretical implications

This study analyzed the role of a firm's CSR reputation in moderating negative stakeholder reactions to CSIR. Our analysis, based on the data from a vignette-based experiment with supply chain professionals, yielded several important theoretical implications. We addressed a number of recent calls for more research on the topic of CSIR (e.g., Lin-Hi & Blumberg, 2018; Lin-Hi & Müller, 2013), CSR-related crisis management (e.g., Janssen et al., 2015; Lenz et al., 2017; Shiu & Yang, 2017), the implications of utilizing substantive and symbolic CSR actions (Hawn & Ioannou, 2012, 2016), and industrial buying contexts (Homburg, Stierl, & Bornemann, 2013) to fill an important and relevant gap in the current academic discussion on the value of ex ante CSR reputations at times of crises.

First, we contribute to the body of literature that explicitly distinguishes between CSR and CSIR as two different constructs. This distinction is central to our research

design, as CSR comprises voluntary activities of a firm to "do good" while CSIR reflects a firm's inability to "avoid bad." Our findings address the relationship between CSR and CSIR and provide insights into their effect on the intentions of stakeholders. More specifically, as suggested by prior research (e.g., Lin-Hi & Blumberg, 2018; Lin-Hi & Müller, 2013), our results highlight that preventing (severe) CSIR is a precondition for firms to effectively utilize their CSR reputation.

Second, and in line with previous research, our study highlights that it is important to distinguish between different facets of CSR (Hawn & Ioannou, 2012, 2016). Moreover, this study's results provide empirical evidence that the distinction between substantive and symbolic CSR is relevant not only in business-to-consumer (B2C) but also in B2B contexts. The circumstance that our result do not provide support for Hypotheses 3a and 3b might have been driven by compliance concerns and issues from the participants' own work environments. Such concerns might have affected the results in a way that the more favorable attribution of substantive CSR were not sufficient to mitigate the perceived negativity of the presented CSIR incident. This would highlight an important difference between consumers and professional buyers.

Third, beyond adding further empirical support to the observation that insurance-like or risk-mitigating effects of CSR do not always hold (e.g., Sen & Bhattacharya, 2001), we contribute to specifying the boundary conditions of these effects and demonstrate that whether a firm benefits from "doing good" or not (when it is involved in CSIR) depends on the nature of a firm's CSR reputation (substantive/ symbolic) and CSIR severity. The results suggest that both substantive and symbolic CSR reputations mitigate negative stakeholder reactions to corporate environmental and social misconduct if the severity of a specific CSIR incident is low. When firms are involved in severe CSIR the effect of ex ante CSR can switch from insulation to amplification. Prior research has found that severe CSIR incidents can recalibrate stakeholders' expectations (Huq, Chowdhury, & Klassen, 2016). Our results add to this insight by demonstrating that in case of severe CSIR, the effect of a firm's CSR reputation on negative stakeholder reactions depends on its nature and the specific dimension of the stakeholder reaction. While firms with substantive CSR reputations seem not to benefit from their ex ante activities regarding negative stakeholder reactions to severe CSIR, stakeholders of firms with reputations driven mainly by symbolic CSR actions even express higher intentions to engage in nWOM compared to stakeholders of firms that have no reputation for CSR.

For PI, we were not able to find sufficient statistical evidence to show that the reactions of stakeholders to severe CSIR depend on the CSR reputation. This must not be interpreted as evidence that there is no effect. Methodological reasons might have influenced this result. For example, in case of symbolic CSR, contrast effects resulting in a change of both PI and nWOM might require higher levels of CSIR severity. Similarly, the chosen description of high severity might already represent a level too high for substantive CSR to result in assimilation effects. The incident described in our experimental material might have been too severe to be attenuated by favorable attributions of a firm's CSR motives. However, a possible explanation for the lack of evidence to support Hypothesis 4a is that for an individual's PI, it might not be relevant whether substantive or symbolic CSR engagement has formed stakeholder expectations. In case of severe CSIR, the disparity between a customer's expectations and a firm's true performance might be perceived as similar for both substantive and symbolic actions since they can also be equally successful in gaining legitimacy and fostering expectations. Customers might be more willing to share the disconfirmation of their expectations if firms used symbolic actions instead of no CSR engagement to affect their expectations based on the perceived motives of a firm's CSR engagement. Once ex ante CSR efforts are identified as greenwashing, they cast doubt on a customer's prior expectations. To prevent others within their peer group from building high expectations based on symbolic CSR engagement, customers seem to be more willing to engage in nWOM than if the expectations were based on substantive CSR or no CSR engagement at all.

Finally, our findings enhance our understanding of the impact of CSR on industrial buying situations. To the best of our knowledge, this is the first study that explicitly addresses the role played by ex ante CSR reputations on CSIR-related disruption management in a B2B environment. Previous research has highlighted that many decision makers might not be aware of the benefits associated with CSR-related activities along their firms' supply chains (Paulraj, Chen, & Blome, 2017), but we provide empirical support for implementing CSR based on instrumental rather than moral motives. Moreover, prior studies have focused on the B2C perspective and important consumer outcomes, such as satisfaction and loyalty. Although these findings may partially hold true in B2B contexts, it is well-researched that professional buyers differ considerably from consumers. Thus, we focused on customer outcomes, considered characteristics of industrial buying, and addressed a highly relevant topic because our research is among

the first studies to empirically analyze positive effects of CSR actions in industrial buying contexts (Homburg et al., 2013). As firms are increasingly held responsible for misconduct within their supply chain, the implications of our study extend previous work by emphasizing that not only firms which are positioned downstream the supply chain can considerably benefit from CSR but also those which are further upstream and less visible to consumers (C. G. Schmidt, Foerstl, & Schaltenbrand, 2017).

3.5.2 Managerial implications

Several implications for managerial practice can be deduced from the results. Given the study's focus on industrial buying contexts, a key insight is that CSR engagement is worthwhile not only in B2C but also in B2B contexts. Both substantive and symbolic CSR reputations can have insurance-like effects in case of non-severe CSIR in industrial buying situations. This provides a strong justification for managers to pursue an intensified engagement in CSR to benefit from mitigated negative stakeholder reactions in case of misconduct. In addition, the study's findings underline the necessity of managers to proactively reflect on different stakeholders and their expectations, as delineated in previous work (Gualandris, Klassen, Vachon, & Kalchschmidt, 2015). However, our results suggest that engaging in CSR without considering the nature of the specific actions can backfire in times of crises. Customers can distinguish between substantive and symbolic actions, which has important repercussions on their behavior. CSR reputations based on symbolic actions cannot fully avoid more intense negative stakeholder reactions when a firm is involved in severe CSIR. Thus, managers should be aware of the nature of their firm's own CSR engagement. Prior research highlights that the decision to pursue substantive or symbolic CSR activities depends on cost-benefit considerations (e.g., Christmann & Taylor, 2006; Durand et al., 2017; Kaul & Luo, 2018). However, based on our results, if the expected probability of severe environmental or social misconduct is considerably high, managers should be careful about addressing stakeholder demands with potentially backfiring symbolic CSR actions. In this case, managers might rather decide to invest in substantive CSR activities instead. Compared to merely symbolic CSR claims that do not entail specific changes in business processes, substantive CSR has the potential to mitigate environmental and social risk while offering insurance-like effects if a firm is involved in non-severe CSIR.

In addition, our findings suggest that managers who decide to engage merely in "doing good" to develop a firm's reputation for CSR might not always benefit from a competitive advantage over firms that provide similar products but do not have a reputation for CSR. When (potential) customers are confronted with a supplier's involvement in severe CSIR, firms with CSR reputations driven by substantive CSR actions seem to perform just as good as firms that do not have a reputation for CSR. Firms that engage mainly in symbolic actions might even have a disadvantage and suffer more than do firms that do not promote themselves as socially responsible. This underlines the need for managers to also consider "avoiding bad" as a precondition to benefit from voluntary CSR engagement. Hence, more attention, effort, and resources should be invested in mitigating the risk that CSIR occurs within their firms' supply network to effectively utilize a firm's reputation for CSR, since engaging in CSR does not automatically provide protection against negative stakeholder reactions.

3.5.3 Limitations and future research opportunities

This study and its findings are subject to certain limitations, which provide fruitful avenues for future research. The participants examined scenarios containing information about a specific one-shot buying situation describing a potential supplier's CSR reputation and involvement in CSIR. In real industrial buying processes, the participants are likely to receive such information in a more fragmented fashion, perhaps over multiple time periods. Moreover, we focused on individuals with centralized decision making authority and one single supplier option to choose from, which might often deviate from organizational practice. Thus, further research should account for the dynamics of organizational buying processes and buying decisions of teams while considering multiple supplier options would add to further support the validity and generalizability of our findings. In addition, field experiments investigating the effect of CSR reputations on stakeholder reactions to CSIR would also contribute an increased generalizability of our findings, although we carefully designed our experiment to provide externally valid results. This is especially important, because the use of vignettes enabled us to analyze only the participants' intentions rather than their actual behaviors. Still, ample empirical evidence suggests that intentions may serve as reliable indicators of actual behavior (e.g., Ajzen, 1991; T. L. Webb & Sheeran, 2006).

In the manipulations of CSR reputations, we have focused on describing firms with and without a reputation for CSR. This means that we kept the "strength" of a reputation for CSR constant. Future research might investigate whether the effects described in our study can be replicated with reputations of different strength. To generate insurance-like effects, reputations for CSR might have to exceed a certain threshold of power. Prior research, for instance, has highlighted that short histories of CSR engagement are not sufficient to mitigate negative stakeholder reactions to CSIR (Vanhamme & Grobben, 2009).

This study took a single episode perspective, although firms might be involved in several recurring incidents of environmental and social misconduct over time. A promising direction for future research is to investigate whether and how a reputation for CSR immunizes against CSIR in multi-period settings. For example, initial insurance-like effects of reputations for CSR could end up having an aggravation effect in case of recurring involvement in CSIR. Customers might tolerate minor isolated performance deviations from their expectations, but once a firm is involved in several cascading CSIR incidents, its CSR reputation might not provide protection anymore and could, on the contrary, lead to aggravated negative reactions. Just recently, Shiu and Yang (2017) reported diminishing insurance-like effects of CSR. However, as they did not distinguish between substantive and symbolic CSR engagement and focused on investors, some open questions regarding the evanescence of the insurance-like mechanism of ex ante CSR remain.

Moreover, the effects of substantive and symbolic CSR on negative stakeholder reactions might be closely related to trust. Trust might affect an individual's effort used to distinguish substantive from merely symbolic CSR while a customer's perception of a firm's CSR might influence the effect of service failure on customer trust (Bozic, 2017; Choi & La, 2013). Hence, exploring how trust affects the moderating role of CSR regarding the link between CSIR and negative stakeholder reactions is a promising avenue for future research.

Another interesting avenue for future research could be to investigate whether professional buyers differ considerably from consumers regarding how they react to firms with a reputation for CSR that are involved into CSIR. On the one hand, consumers might react even more negatively to severe misconduct, regardless of the nature of a firm's CSR reputation, especially if switching costs are low. On the other hand, whether a large

disparity between expectations and a firm's true performance will be tolerated might depend on the loyalty of a consumer. In addition, the behavior of professional buyers is subject to corporate governance rules and standard operating procedures that determine compliant behavior. These constraints might limit the response options or even dictate a specific behavior. This aspect has not been considered in our experimental design.

Another limitation of this study is the relatively moderate sample size. Of special interest for future research could be the potential boomerang effects regarding Hypothesis 4b. This study indicates that symbolic CSR engagement can potentially backfire following CSIR but it does not analyze the underlying cause of this effect in more detail. More specifically, subsequent studies might investigate why symbolic CSR merely led to more negative stakeholder reactions concerning nWOM but not PI. In addition and closely related to the aforementioned issue, for PI as dependent variable, conclusions based on our results need to be drawn with caution due to the limited evidence provided by the only marginally significant interaction effect of CSR reputation and CSIR severity. Hence, to achieve a higher generalizability regarding the generated insights, we encourage the validation of our results using a larger sample.

Finally, choice behavior might also vary with the cultural background of respondents. We chose to limit the empirical study to Germany, Austria, and Switzerland, because from a cultural perspective, these three countries are usually considered to be very similar and homogeneous (Hofstede, 1984, 2003). A relevant next step would be to scrutinize the robustness of the effects across different cultural regions. People from North America, for example, differ from the population sampled in this study in that they display lower uncertainty avoidance and higher degree of individualism. It could be conjectured that North American supply chain professionals are less affected by the uncertainty created by the discrepancy between a firm's CSR reputation a case of misconduct (lower uncertainty avoidance), although at the same time, they could be less willing to engage in negative word-of-mouth (higher degree of individualism).

Chapter 4 Supply disruption management: The early bird catches the worm, but the second mouse gets the cheese?

Co-author:

Christoph Bode
Endowed Chair of Procurement, Business School, University of Mannheim, Germany

Abstract[6]

In the direct aftermath of supply disruptions, managers typically face uncertainty in the form of incomplete or unreliable information about the consequences of possible response actions. To gain a better understanding of how to recover from disruptions and support effective disruption management, this study pursues a multi-method research approach. First, we propose an agent-based simulation model of supply disruption responses and recovery processes to reveal how managers *should* behave. Based on this model, we analyze the performance outcomes of a decision maker's tendency to reduce uncertainty by collecting further information before taking action (ready-aim-fire) or to act immediately (ready-fire-aim) under different conditions. Second, vignette-based experiments with supply chain professionals are conducted to show how managers *actually intend to* behave in supply disruption recovery. The findings suggest that managers' intentions deviate from how they *should* behave and that quick reactions to disruptions can be beneficial, even if the exact consequences of a response action cannot precisely be determined. Furthermore, in complex environments, ready-fire-aim leads to a better average performance than ready-aim-fire, if response uncertainty is not very high. The derived insights provide novel theoretical and managerial implications for effective disruption management.

[6] Merath, M. and Bode, C., 2018. Supply disruption management: The early bird catches the worm, but the second mouse gets the cheese? *Unpublished Working Paper*, 1-45. An earlier version won the "Chan Hahn Best Paper Award" of the Operations and Supply Chain Management Division of the Academy of Management at the Annual Meeting in Atlanta, GA, in 2017.

4.1 Introduction

Supply chain disruptions are defined as "unplanned and unanticipated events that disrupt the normal flow of goods and materials within a supply chain […] and, as a consequence, expose firms within the supply chain to operational and financial risks" (Craighead et al., 2007, p. 132). In the last decades, firms' risk of being harmed by disruptions seems to have increased (Sodhi, Son, & Tang, 2012). On the one hand, modern supply chains have evolved into more complex and vulnerable interconnected networks (Bode & Wagner, 2015). On the other hand, natural disasters are becoming more frequent (Munich Re, 2015).

Many types of supply chain disruptions – especially those characterized by high impact and low probability – cannot be completely avoided. The decisions that managers take in response to severe disruptions inevitably affect the success of a firm's recovery, as demonstrated by the often-cited Albuquerque fire (Latour, 2001). On March 17, 2000, a Philips plant in Albuquerque, New Mexico, was hit by lightning and caught fire. Initially, it seemed that the damage would be limited. Philips informed the two main customers of the chips produced in this plant, Nokia and Ericsson, about an expected delivery delay of one week. Yet, the responses of the two competitors were completely different. Nokia reacted directly, put pressure on Philips, and collaborated with alternative suppliers to rebound from the disruption with minimal negative consequences. Ericsson adopted a "wait and see" approach and delayed remedial action until more information became available. When it was clear that the damage to the clean rooms was far more substantial than expected, Ericsson was not able to find an alternative supplier on short notice and had to delay the launch of a new product while losing market share to Nokia (Latour, 2001; Sheffi, 2005).

The possible losses that supply chain disruptions may entail are well-researched (Hendricks & Singhal, 2005a,b), but the process of reactive supply disruption management has received only limited research attention. In particular, our understanding of how firms should respond to supply chain disruptions in order to quickly recover is weak (Bode et al., 2011; Macdonald & Corsi, 2013). This issue is important, because a firm's ability to effectively respond to sudden disruptions is critical to both its short-term performance and long-term competitiveness.

Responding to disruptions usually requires decision making in complex environments characterized by uncertainty and limited information. Under these conditions, some firms defer actions until (most of) the uncertainty has been resolved and reliable information is available, while other firms respond immediately, even though the information at hand is cloudy (Kleinmuntz & Thomas, 1987). Using the analogy of shooting, the first approach can be termed *ready-aim-fire* (RAF) and the second *ready-fire-aim* (RFA). Intuitively, RAF may lead to more precise actions than RFA, but loss is typically a function of time and RAF may also allow quicker competitors to obtain superior positions. Conversely, RFA carries the inefficiencies of trial and error and, when decisions are irreversible and path-dependent, the risk of pursuing an inferior recovery path. Hence, the key question is: Under which circumstances *should* a manager delay its response actions until more evidence is acquired and how do managers *actually intend to* behave?

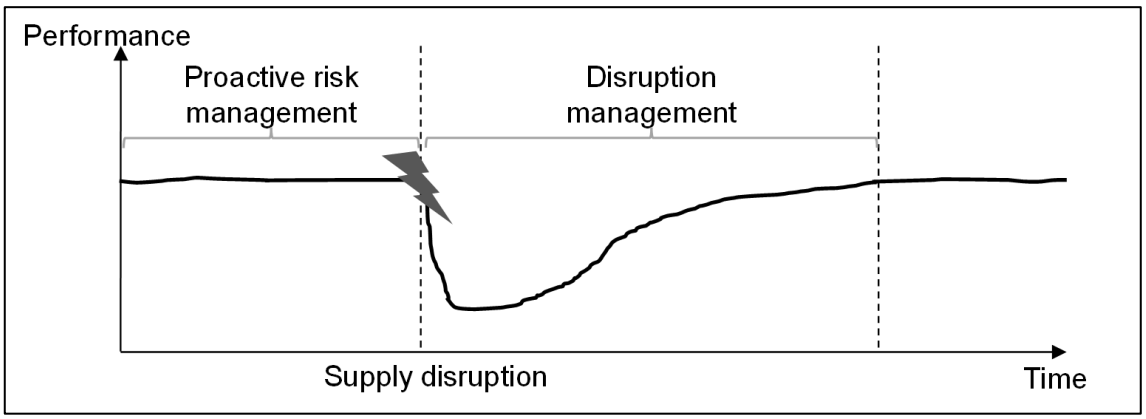
This study addresses this issue by means of a multi-method research approach. First, we develop an agent-based model to perform simulation experiments and delineate how managers *should* theoretically behave in disruption response situations. Second, we conduct vignette-based experiments with supply chain managers to adopt a more behavioral perspective and demonstrate how managers *actually intend to* approach disruption recovery as opposed to how they *should* behave. The results provide insights into effective decision making in the aftermath of supply chain disruptions and contribute to the knowledge of supply chain disruptions management.

4.2 Supply disruption management and resilience

The complexity and interconnectedness of modern supply chains create vulnerabilities that expose firms to the risk of being affected by severe disruptions of the flows of materials, information, and funds (Sheffi, 2005). A supply chain disruption is a combination of an unforeseen event that interrupts these flows and a subsequent situation that distorts the normal course of a focal firm's business operations. We focus on disruptive events that cannot be resolved in the course of daily operations management and that occur in a focal firm's upstream supply chain (in the following: *Supply disruptions*). It has been suggested that supply chain disruptions "are more critical when they occur upstream in the chain" (Pereira et al., 2014, p. 627).

There is a large body of literature on these disruptions and the management of supply chain risks (e.g., Heckmann et al., 2015; Rao & Goldsby, 2009). In these works, there is an agreement that supply disruptions have a certain time profile regarding their adverse effects on firm performance (Sheffi, 2005). As shown in Figure 7, a disruption leads to a sudden drop in operating performance which then triggers search and recovery efforts (Bode et al., 2011).

Figure 7: Typical supply disruption profile



Although supply disruptions may have serious negative consequences for firm performance, many firms prove themselves unprepared (Handfield, Blackhurst, Elkins, & Craighead, 2007). The ability to recover from disruptive events is a major component of a firm's resilience, a concept which has been widely used in numerous disciplines. Resilience is the "ability of a system to return to its original state or move to a new, more desirable state after being disturbed" (Christopher & Peck, 2004, p. 2). In the supply chain context, Sheffi (2005) defined resilience as the ability and the speed at which firms fully recover (i.e., return to normal performance levels) from high-impact/ low-probability disruptions. He added that when "thinking about resilience, it may not be productive to think about the underlying reason for the disruption – the kind of random, accidental, or malicious act that may cause a disruption. Instead, the focus should be on the damage to the network and how the network can rebound quickly" (p. 14). For this reason, this investigation does not focus on the causes of supply disruptions but solely on their impact on operating performance.

4.3 How managers should behave in supply disruption response situations

4.3.1 A model of supply disruption recovery

To recover from a disruption, managers need to actively adjust their firms' operations (Blackhurst, Craighead, Elkins, & Handfield, 2005; Chakravarthy, 1982), which can be interpreted as an adaptation process. Our model of this process is based on the NK model (Kauffman, 1993; Levinthal, 1997) and is similar to recent organizational research using agent-based modeling (e.g., Chandrasekaran, Linderman, Sting, & Benner, 2016; Siggelkow & Rivkin, 2005). Many models of organizational behavior focus on closed-form solutions that maintain analytical tractability by substantially simplifying the representations of organizations their environments. Agent-based modeling allows us to consider more complex settings than closed-form approaches and to generate meaningful hypotheses as a basis for empirical studies (Siggelkow & Rivkin, 2005). Following Burton and Obel (1984, 1995, 2004), we build a model that is just as complex as necessary. It "should not be seen as a literal representation of environments and organizations, but as the simplest representation that can fulfill our intended purpose" (Siggelkow & Rivkin, 2005, p. 103).

Fundamental to our study is to view firms as information-processing systems (Galbraith, 1977; Thompson, 1967; Tushman & Nadler, 1978). According to information-processing theory (IPT), responses of organizations to environmental changes are driven by sequential information-processing activities (Barr, 1998; Dutton, Fahey, & Narayanan, 1983). IPT has been widely used to study organizational decision making processes subsequent to exogenous changes (e.g., Bode et al., 2011). Most notably, Mintzberg, Raisinghani, and Theoret (1976) identified general steps of strategic decision making that form an iterative incremental process: Identification, development, and selection. Hale, Hale, and Dulek (2006) transferred this process model to crisis responses and found that *recognition* (problem discovery and identification of a need to take a decision), *search* (for information and alternative actions), and *evaluation/ choice* of response options are common crisis recovery stages. Since crisis response processes are comparable to disruption response processes, we consider these stages part of a firm's disruption response process.

4.3.2 The environment

We assume that each decision maker faces a choice problem consisting of N different binary decisions. These decisions represent the configuration of the firm's activities and determine the overall performance given the environment. Examples of such decisions include the selection of a supplier, the logistics and delivery concept, or whether a specific material can be substituted or not. A specific instance of a firm's choices is called *choice configuration* and denoted by the decision vector $\mathbf{d} = (d_1, \ldots, d_i, \ldots, d_N) \in \{0, 1\}^N$. The choice configurations are evaluated by a *fitness value* function $F = F(\mathbf{d})$ which expresses the firm performance the decision makers seek to maximize.

The contribution of each decision i to the fitness value depends not only on its own state d_i (0 or 1) but also on the complexity of the environment. A large number of decisions (N) does not make a problem complex per se, because complexity emerges from elements of a system "that interact in a nonsimple way" (Simon, 1962, p. 468). We regard these interdependencies as characteristics of a firm's environment, because they "are dictated by the nature of the decisions themselves and […] are not chosen by the firm" (Siggelkow & Rivkin, 2005, p. 103). The complexity of an environment is expressed by the intensity of interactions among the N decisions specified by the parameter $K \in \{0, 1, \ldots, N-1\}$. K determines the number of decisions upon which the contribution of each decision i depends. We denote the state of these K decisions by the vector $\mathbf{d}_{-i} = (d_{i1}, \ldots, d_{iK}) \in \{0, 1\}^K$. The fitness contribution of each decision i is evaluated by a contribution function $C_i = C_i(d_i, \mathbf{d}_{-i})$. If K equals 0, C_i depends solely on the state of d_i. If K equals $N - 1$, C_i depends on d_i and the states of all other decisions.

After N and K have been specified, a pattern of interaction among the decisions is created. K decisions are randomly assigned to each decision i. For each of the possible 2^{K+1} realizations of d_i and $\mathbf{d}_{-i}$, a contribution C_i is generated by drawing a random number from a standard uniform distribution (i.e., $C_i \sim U(0, 1)$). This is repeated for all N decisions. The fitness value of a choice configuration $\mathbf{d}$ is then defined as the average of the contributions of each decision:

$$F(\mathbf{d}) = \frac{\sum_{i=1}^{N} C_i(d_i; \mathbf{d}_{-i})}{N}. \tag{7}$$

All 2^N possible choice configurations and their respective fitness values form a firm's environment (e.g., Chandrasekaran et al., 2016; Levinthal, 1997). Interactions

among decisions cause environments to become "rugged" and multipeaked instead of smooth and equipped with single optima. If *K* equals 0, a change of a single decision leaves the contributions of all other decisions unaffected and the fitness value can always be improved by changing each decision to the state with the highest contribution. If *K* is larger than 0, environments become "rugged" in a sense that changing the state of one decision from 0 to 1 or vice versa also affects the fitness contributions of *K* other decisions, leading to multiple local optima. The number of the latter tends to increase with *K*, making the search process for a high peak increasingly difficult.

4.3.3 Organizational adaptation to environmental change

Firms adapt to their environment by means of sequential dynamic search processes and corresponding information processing (e.g., Ethiraj & Levinthal, 2004; Katila & Ahuja, 2002; Levinthal, 1997; March & Simon, 1958). Due to the bounded rationality of decision makers and firms, the alternatives of how to adapt to environmental changes are not entirely and instantly known and must first be searched or discovered (Simon, 1955). These search processes are guided by "satisficing" rather than by optimizing (Simon, 1979).

The behavioral theory of the firm suggests that organizational search is problem-oriented and triggered by performance shortfalls (Cyert & March, 1963). Furthermore, firms tend to search locally for alternative actions (March & Simon, 1958; Winter, Cattani, & Dorsch, 2007). They modify their configuration by identifying and implementing superior configurations which are part of the immediate "neighborhood of the organization's current practices" (Knudsen & Levinthal, 2007, p. 43). In line with previous research on NK models, we follow the central assumption of local search (e.g., Gavetti, Levinthal, & Rivkin, 2005; Winter et al., 2007). During our simulation experiments, firms examine alternative choice configurations which differ from their current choice configurations in the state of one of the *N* decisions, selected at random. If it provides a greater fitness value than the current choice configuration, the state of the respective decision is changed (i.e., from 0 to 1 or vice versa). Otherwise, the choice configuration remains unchanged. This procedure is repeated in every period and often termed local "hill climbing" (Levinthal, 1997).

An environmental change can have various causes and take many forms. When it comes to events such as supply disruptions, firms tend to centralize and assign decision

making responsibility to a single manager ("troubleshooter") or team (Dubrovski, 2004). Accordingly, agents in our simulation model can be seen as individual decision makers or teams that have been tasked with the recovery decisions. Their behavior is predefined by a set of rules.

4.3.4 Supply disruptions and uncertainty

Uncertainty is a central concept for research concerned with the relationship between organizations and their environments (e.g., Dill, 1958; Duncan, 1972; Thompson, 1967). In congruence with the information-processing perspective, we build on the notion that uncertainty and information are closely interrelated. Uncertainty is defined "as a manifestation of some information deficiency, while information is viewed as the capacity to reduce uncertainty" (Klir, 2005, p. xiii). For decision makers, uncertainty is the "difference between the amount of information required to perform a task and the amount of information already possessed" (Galbraith, 1973, p. 5). Gathering information to reduce uncertainty is a critical activity for decision making (Cooper, Folta, & Woo, 1995).

Three types of environmental uncertainty can be distinguished: State, effect, and response uncertainty. State uncertainty involves the inability to understand or predict the state of the environment, while effect uncertainty impairs an individual's ability to predict the impact of environmental changes on organizations (Milliken, 1987). For actions, response uncertainty is the most prevailing issue (McMullen & Shepherd, 2006). It is defined as a "lack of knowledge of response options and/or an inability to predict the likely consequences of a response choice" (Milliken, 1987, p. 137) and is salient in almost every supply disruption recovery process. It is experienced when there is a perceived need to act or formulate "a response to an immediate threat in the environment" (Milliken, 1987, p. 138). Especially in the early stages of a disruption response, information on causes and effects tends to be incomplete or inaccurate (M. Chen, Xia, & Wang, 2010).

From a behavioral perspective, uncertainty is associated with "a sense of doubt that blocks or delays action" (Lipshitz & Strauss, 1997, p. 150). The potential costs of an incorrect response may deter a decision maker from taking action (Milliken, 1987). However, delaying a decision is also costly and may allow competitors to respond faster to disruptions. Research on disruption management has provided anecdotal evidence that the disruption recovery performance is time-dependent (Macdonald & Corsi, 2013). Yet,

we still lack convincing evidence on the link between response speed and recovery performance.

In previous research on organizational search behavior, the problem of evaluating response alternatives has been treated as being trivial (Knudsen & Levinthal, 2007). To address this criticism, we investigate the impact of response uncertainty on the evaluation of response alternatives. During every simulation run, the environment is replaced by a new randomly generated environment to represent the effect of a supply disruption. However, the latter is accompanied by response uncertainty and fitness values of alternative configurations are distorted by a uniformly distributed random error. The firms differ in the way they react to this response uncertainty as described in the next sections.

4.3.5 Disruption response strategies

Search processes of firms are affected by preferences and characteristics of individuals. Decision makers may differ in the degree of risk avoidance (e.g., depending on cultural differences (Hofstede, 1993)) or the preferred amount of information collected to solve a problem (O'Reilly, 1982). Accordingly, some organizations penetrate their environment more than others. Daft and Weick (1984) noted that "organizations may leap before they look" (p. 288). Against this backdrop, we distinguish two disruption response strategies under response uncertainty: Ready-aim-fire and ready-fire-aim. These strategies[7] have been mentioned in the fields of management, strategy, and decision theory (e.g., Cox, 2000; Peters & Waterman, 1982), but, to the best of our knowledge, have not been clearly delineated.

Ready-aim-fire (RAF). In the face of uncertainty, some firms may prefer to delay a decision until more information becomes available (Kleinmuntz & Thomas, 1987). A firm can receive additional information passively (e.g., via media announcements) or actively (e.g., through its own investigations) (Milliken, 1987). Action is delayed in the hopes that less uncertainty makes the choice of an appropriate alternative easier and more accurate. Borrowing an analogy from marksmanship, we call this strategy *ready-aim-fire*. Its main idea is to reduce response uncertainty and purse accurate analysis before action is taken (Lipshitz & Strauss, 1997; Mintzberg & Westley, 2001; Peters & Waterman,

[7] Similar terms that can be found in the literature are "look before you leap" vs. "leap before you look", "judgment-oriented" vs. "action-oriented", or "wait and see"/ "watchful waiting" vs. action.

1982) and it can be seen as the rational or "proper" sequence to problem solving. In general, the rational decision making approach consists of the stages problem definition, diagnosis, design of alternatives, and selection of the preferred option (Mintzberg & Westley, 2001). These steps are conducted sequentially, with diagnosis as an action-enabling step. As organizational decision making processes tend to be incremental, they involve iterative cycles of design and readjustment (Mintzberg et al., 1976).

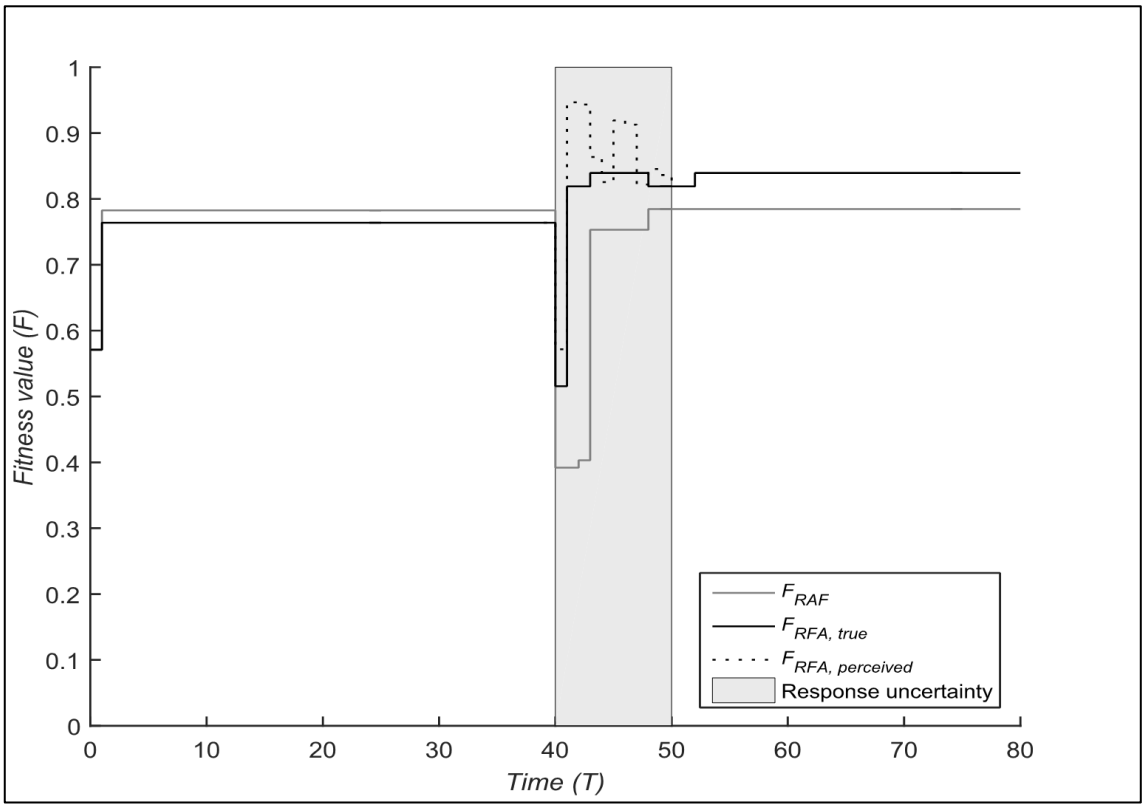
Ready-fire-aim (RFA). In practice, firms often do not follow the rational RAF strategy. Empirical insights reveal that managers are inclined to prefer quick action to analysis (Isenberg, 1984; Mintzberg et al., 1976). The studies of Mintzberg (1973) about what managers *actually* do, as opposed to what they are *supposed* to do or what they *say* they do, indicate that rational problem solving was rarely employed. Instead, an action-orientation has frequently been observed (Isenberg, 1986; Mintzberg & Westley, 2001). Taking action provides orientation and information that enables to learn and adjust response efforts (Rudolph, Morrison, & Carroll, 2009). We call this strategy *ready-fire-aim*. It has been recognized in innovative firms, which tend to act rather than analyze, plan, and postpone action (Peters & Waterman, 1982). Weick (1979) argued that "postponing action while planning continues could prove dangerous [...] and any chance of clarifying the situation will decrease, simply because there is nothing available to be clarified or made meaningful" (p. 103). In case of dramatic change, he suggested that "chaotic action is preferable to orderly inaction" (p. 245). Daft and Weick (1984) added that "feedback from organizational actions may provide new collective insights" (p. 286) which may improve both the understanding of a situation as well as the ability to implement an effective response. Accordingly, RFA is based on Weick's (1979) idea of organizations engaging in iterative cycles of action and reaction to gradually reduce uncertainty related to environmental information.

In our model, a firm that applies RAF uses the first period after a supply disruption to collect information and resolve the response uncertainty while its choice configuration remains unchanged. Afterwards, the firm engages in local search and is able to perfectly predict the fitness values of alternative configurations. In contrast, a firm that applies RFA immediately starts local search after a supply disruption and faces noisy information due to response uncertainty. In line with G. Wu (1999) – who suggested that "uncertainty about the outcome of a particular state of nature is often not resolved immediately after an act is selected" (p. 159) – we assume that response uncertainty is dynamic and does

not completely vanish after action has been taken. Hence, the fitness values of both a firm's current configuration and alternative configurations are distorted by uniformly distributed random errors for *D* periods. The random errors are newly generated in each period and are part of an interval of a pre-defined value *E* of standard deviations (*SD*) of all fitness values of a given environment and range from $-E \times SD$ to $E \times SD$. The size of this interval decreases linearly over time. If the duration of response uncertainty *D* equals 5, the interval will shrink by 20 percent of its initial size in each period and the response uncertainty is resolved after 5 periods.

Figure 8 depicts an individual simulation run over 80 periods of time. For every period of time (*x*-axis), the corresponding fitness value for each firm (agent) is plotted on the *y*-axis. The firm pursuing RFA immediately responds to the disruption in period 40 although fitness values of choice configurations are distorted ($F_{RFA,\ perceived}$, dotted black line). However, the true fitness value ($F_{RFA,\ true}$, solid black line) is reduced by some alterations. The firm pursuing RAF acts later, but does not experience detrimental decisions during its recovery (F_{RAF}, solid gray line). Finally, both firms recover from the disruption's negative consequences reaching different long-term fitness values.

Figure 8: An individual simulation run



Note. The simulation run was conducted in a setting with $N = 6$, K^{high}, E^{medium}, D^{long}, and PD^{none}.

4.3.6 Path dependence

An important characteristic of actual organizational adaptation processes is path dependence (Beinhocker, 1999). Path dependence means that "where we go next depends not only on where we are now, but also upon where we have been" (Liebowitz & Margolis, 2000, p. 981). Adaptation decisions may influence the available range of future options and future flexibility (Nelson, Adger, & Brown, 2007). Serious problems may occur if actions that cannot be reversed in the short term prove to be a "shadow of the past" which results in inferior outcomes creating lock-in situation (J.-P. Vergne & Durand, 2011). Hence, in the face of environmental change, path dependence can force firms on a suboptimal course of action (Noda & Collis, 2001). Recent research has emphasized the need for a better understanding of path dependence (e.g., Sydow, Schreyögg, & Koch, 2009; J. P. Vergne & Durand, 2010).

Recovery from supply disruptions may involve supply chain reconfigurations that are partly or completely irreversible. Moreover, organizational inertia can prevent firms from making possible changes. Imagine that one choice of a firm's decision set concerns a supplier selection decision. It is unrealistic to assume that the decision for a specific supplier can immediately be reversed in the following period without excessive switching costs and time. Against this backdrop, we adopt the view of path-dependent organizational action in the context of adaptation to environmental change. To this end, we include the parameter *PD* in our model. *PD* determines the number of a firm's first alterations that are irreversible. If *PD* equals 0, all decisions can be reversed in subsequent periods. However, if, for example, *PD* equals 2, this means that the first two conducted changes cannot be reversed again and keep their state for the rest of the simulation. Due to this path dependency through irreversible actions, firms can find themselves "locked-in" and not reaching any peak of an environment.

In sum, our model extends the standard NK model as used in previous research. We include response uncertainty in the evaluation of fitness values by means of the parameters *E* and *D*, and incorporate irreversible actions via the parameter *PD*. Thus, the model allows the investigation of response uncertainty, complexity, and path dependence in the context of disruption recovery.

4.3.7 Results

The goal of our simulation experiments is to analyze the conditions under which a firm should decide to delay the initial recovery decision to a point where more accurate information has been accumulated. We generate two firms (agents) with identical initial configurations **d** (without loss of generality) at the beginning of each individual simulation run of 80 periods of time (*T*). Both firms face six decisions ($N = 6$) and operate in the same environment with either low ($K^{low} = 1$) or high complexity ($K^{high} = 5$). This environment is stable until it is disrupted in period 40. The disruption results in an environmental change and the firms' environment is replaced by a randomly generated new one. The parameters *N* and *K* are not altered by the disruption. Subsequently, one firm applies purely RAF to eliminate response uncertainty before it takes action, while the other applies purely RFA facing distorted fitness values to a pre-defined degree *E* for a certain number of time periods *D*. Furthermore, a certain number of the firms' first alterations *PD* is irreversible.

By varying the four parameters *K, D, E,* and *PD,* the simulation model enables sophisticated analyses under a variety of conditions. We focus on parameter values that create diverse settings to derive the implications of RAF and RFA for the recovery performance of firms. The parameter values used in the simulation experiments are depicted in Table 11.

Given this setup, we compare the average recovery performance of RAF and RFA in different settings of our simulation experiments based on four measures which address two main dimensions: Effectiveness and speed. The performance measures we report constitute averages of 10,000 runs to eliminate the stochastic component that any single run is sensitive to. [8]

Effectiveness. The effectiveness of a firm's recovery efforts is a relevant performance indicator, because it reflects the extent to which negative effects on firm performance have been minimized (Bode et al., 2011; Handfield et al., 2007). We

[8] Two additional performance measures – "average first improvement" and "alterations required to recover" – were scrutinized, but did not reveal interesting results beyond the rather obvious insight that RAF always leads to more precise initial actions and requires less changes to recover from disruptions than RFA. For the rest of this paper, we focus on measures that identify different dominant strategies depending on the environmental conditions. Since the degree of complexity influences the absolute levels of fitness in NK landscapes, we measure fitness values in relation to the global optimum of an environment (Skellett, Cairns, Geard, Tonkes, & Wiles, 2005).

construct two effectiveness-related performance measures: *Post-disruption performance* (PDP) and *final performance* (FP).

Speed. Anecdotal evidence suggests that the speed of completing the recovery reduces costs and losses. For example, Macdonald and Corsi (2013) argued that "the longer it takes to fully recover, the more expensive the entire recovery process is likely to be" (p. 272). Two measures are used to capture speed: *Uncertainty resolution performance* (URP) and *number of time periods* (NTP). Whenever we report that one response strategy (RAF/ RFA) performs better than the other, the difference in mean performance is statistically significant with $p < 0.05$ or better.

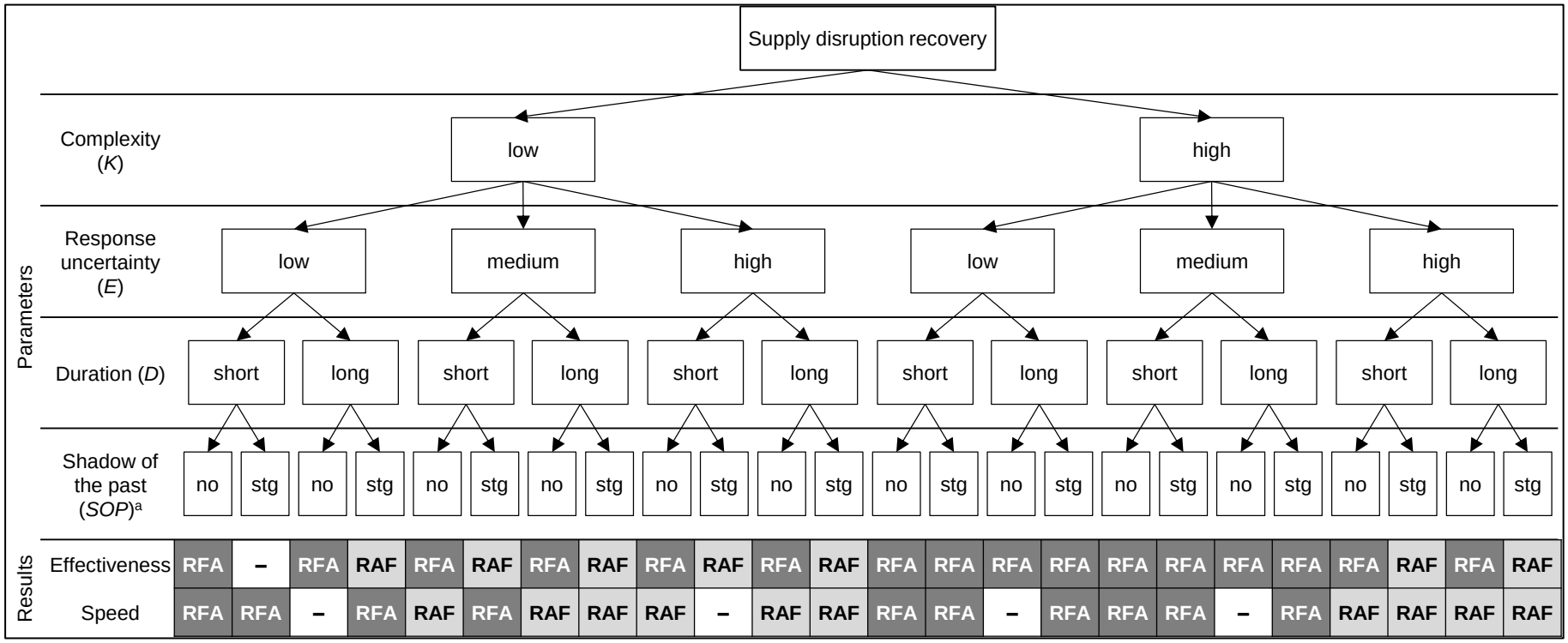
Table 11: Parameter values determining the experimental conditions

(1)	**Number of decisions (*N*)**, one value
	(i) $N = 6$
(2)	**Complexity (*K*)**, two values
	(i) Low: $K^{low} = 1$
	(ii) High: $K^{high} = 5$
(3)	**Duration of response uncertainty (*D*)**, in time periods, two values
	(i) Short: $D^{short} = 5$
	(ii) Long: $D^{long} = 10$
(4)	**Response uncertainty (*E*)**, in standard deviations of an environment's fitness values, three values
	(i) Low: $E^{low} = 0.5$
	(ii) Medium: $E^{medium} = 1$
	(iii) High: $E^{high} = 2$
(5)	**Path dependence (*PD*)**, in decisions, two values
	(i) None: $PD^{none} = 0$
	(ii) Strong: $PD^{strong} = 4$

Figure 9 summarizes the conditions under which a certain response strategy dominates the other on a given performance dimension (effectiveness or speed). Managers should be aware that RAF is more precise in the first period of search and requires less alteration and related investment to find a long-term configuration than RFA in all depicted settings. However, from interviews with procurement executives that we conducted as part of this study, the perception that, in case of a supply disruption, costs are regarded as "*necessary evil*" became apparent, because the goal of a recovery process is "*to maintain the supply of customers, whatever the cost.*"

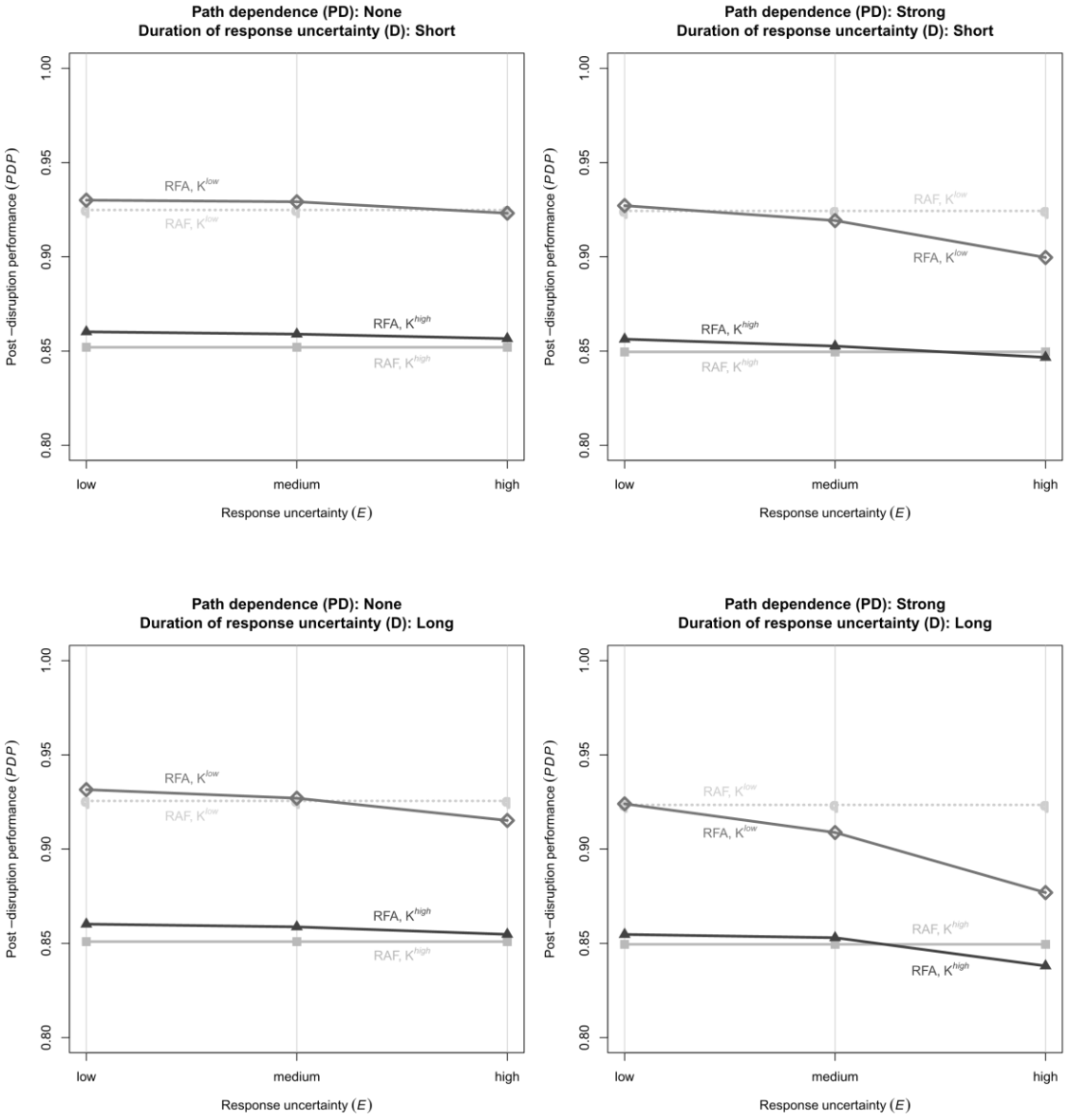
Post-Disruption Performance (PDP). In our simulation, the PDP is the average fitness value of a firm from period 40 to the end of the simulation run. It demonstrates the extent to which negative disruption effects have been minimized. Figure 10 depicts the PDPs of RAF and RFA under various conditions.

Figure 9: Summary of results



Note. The results at the bottom of the tree indicate which strategy (RAF or RFA) is superior in terms of the performance dimensions effectiveness (PDP and FP) and speed (URP and NTP) given the specific parameter configurations. A strategy is superior in a given performance dimension if at least one of both KPIs (PDP and FP for effectiveness, URP and NTP for speed) reflects a better performance while the strategy does not perform weaker in the other KPI. Blank cells (white background, filled with "–") indicate that a superior strategy cannot be determined based on the simulation experiments.
(a) "no" refers to no path dependence (PD^{none}), "stg" refers to strong path dependence (PD^{strong}).

Figure 10: Post-disruption performance (PDP)



The complexity of the respective environments is indicated as either low ($K^{low} = 1$) or high ($K^{high} = 5$). The diagrams' *x*-axes depict three levels of response uncertainty: Low ($E^{low} = 0.5$), medium ($E^{medium} = 1$), and high ($E^{high} = 2$). Disruptions can either be followed by a short ($D^{short} = 5$) or long ($D^{long} = 10$) period of uncertainty and decisions are either reversible ($PD^{none} = 0$) or the first four altered decisions are irreversible ($PD^{strong} = 4$). For each possible combination of *D* and *PD,* one of the four diagrams shown in Figure 10 depicts the average PDP of RAF and RFA on the *y*-axis. Every diagram comprises four lines. The dotted lines refer to RFA and the solid lines to RAF. This basic structure for

the presentation of the simulation results remains the same for all figures which are used in the results section hereafter.

The results shown in Figure 10 provide several interesting insights. If response uncertainty is low, RFA dominates RAF in all settings with respect to PDP. Furthermore, in highly complex environments, this performance advantage of RFA extends to medium response uncertainty. In highly complex environments where actions are reversible, RFA outperforms RAF, regardless of the level and duration of response uncertainty (*D*). However, the advantage of RFA is reduced by increasing path dependence (*PD*). In highly complex environments where actions are irreversible, strong path dependence accompanied by high response uncertainty results in RAF achieving a greater or at least equal PDP compared to RFA. In environments with low complexity and high response uncertainty, RAF dominates RFA, regardless of the intensity of path dependence. If we focus on the implications for complex landscapes (given the premise that most firms operate in complex supply chains and environments), these insights lead to the following propositions:

Proposition 1. *If the environment is highly complex and actions are reversible, then* $PDP_{RFA} > PDP_{RAF}$.

Proposition 2. *If the environment is highly complex, actions are irreversible, and response uncertainty is low or medium, then* $PDP_{RFA} > PDP_{RAF}$.

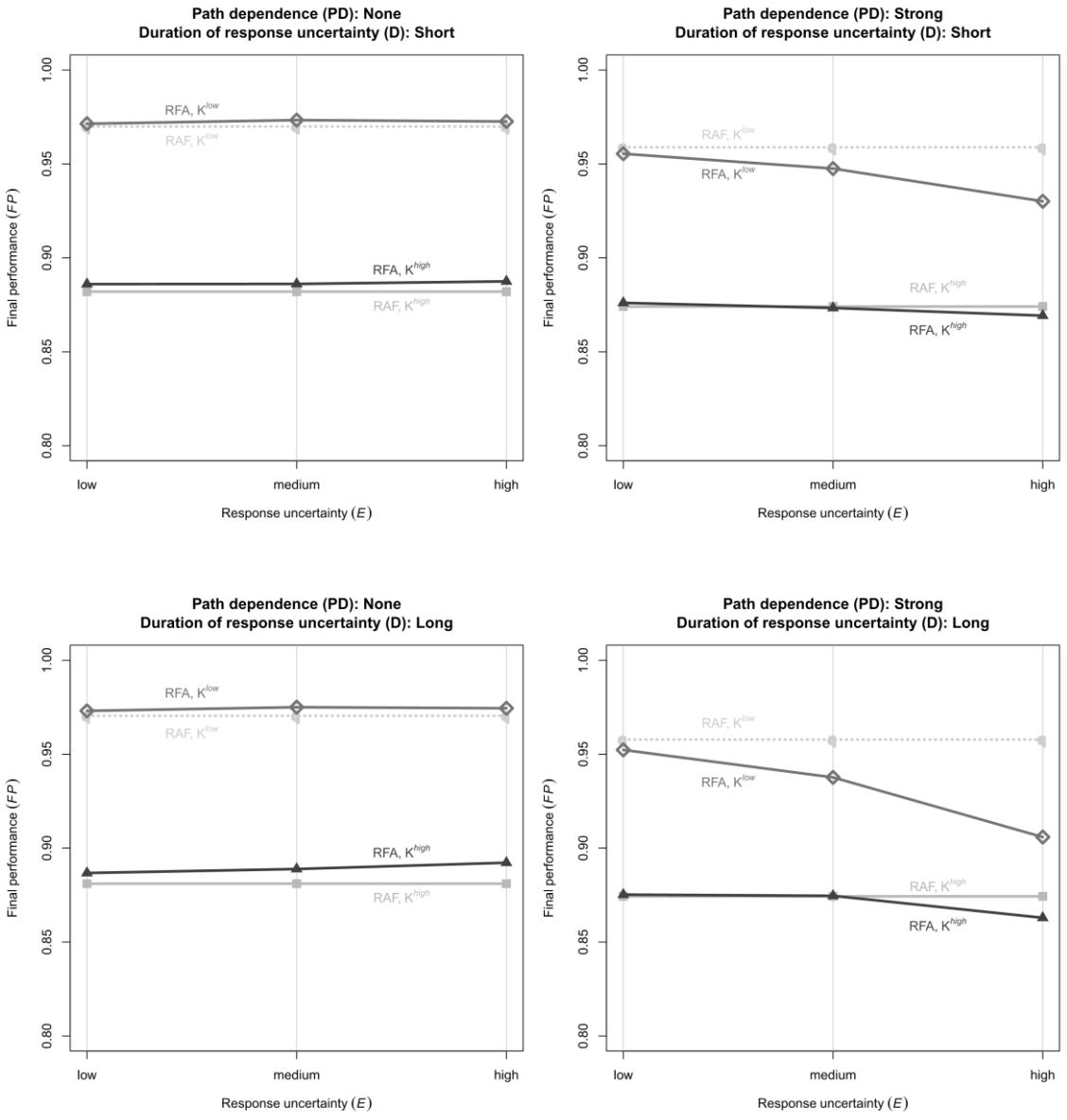
Final Performance (FP). The aim of disruption response is to restore desired performance levels and a firm's ability to do this is depicted by the fitness level of its long-term configuration (FP). To this end, we examine the final fitness values (period 80) of RAF and RFA. Figure 11 reveals that in environments with low complexity, irreversibility of actions leads to greater or at least equal final fitness values for RAF compared to RFA. RAF's performance advantage increases with the level of uncertainty. However, if actions are reversible, RFA leads to greater or at least equal final fitness values compared to RAF in all settings. In highly complex environments, this advantage of RFA increases with the level and duration of response uncertainty. However, if decisions in highly complex environments are irreversible, RAF outperforms RFA if response uncertainty is high. Hence:

Proposition 3. *If actions are reversible, then* $FP_{RFA} \geq FP_{RAF}$.

Proposition 4. *If the environment is highly complex and actions are reversible, then* FP_{RFA} *increases with the level and the duration of response uncertainty.*

Proposition 5. *If the environment is highly complex, actions are irreversible, and response uncertainty is high, then* $FP_{RAF} > FP_{RFA}$.

Figure 11: Final performance (FP)



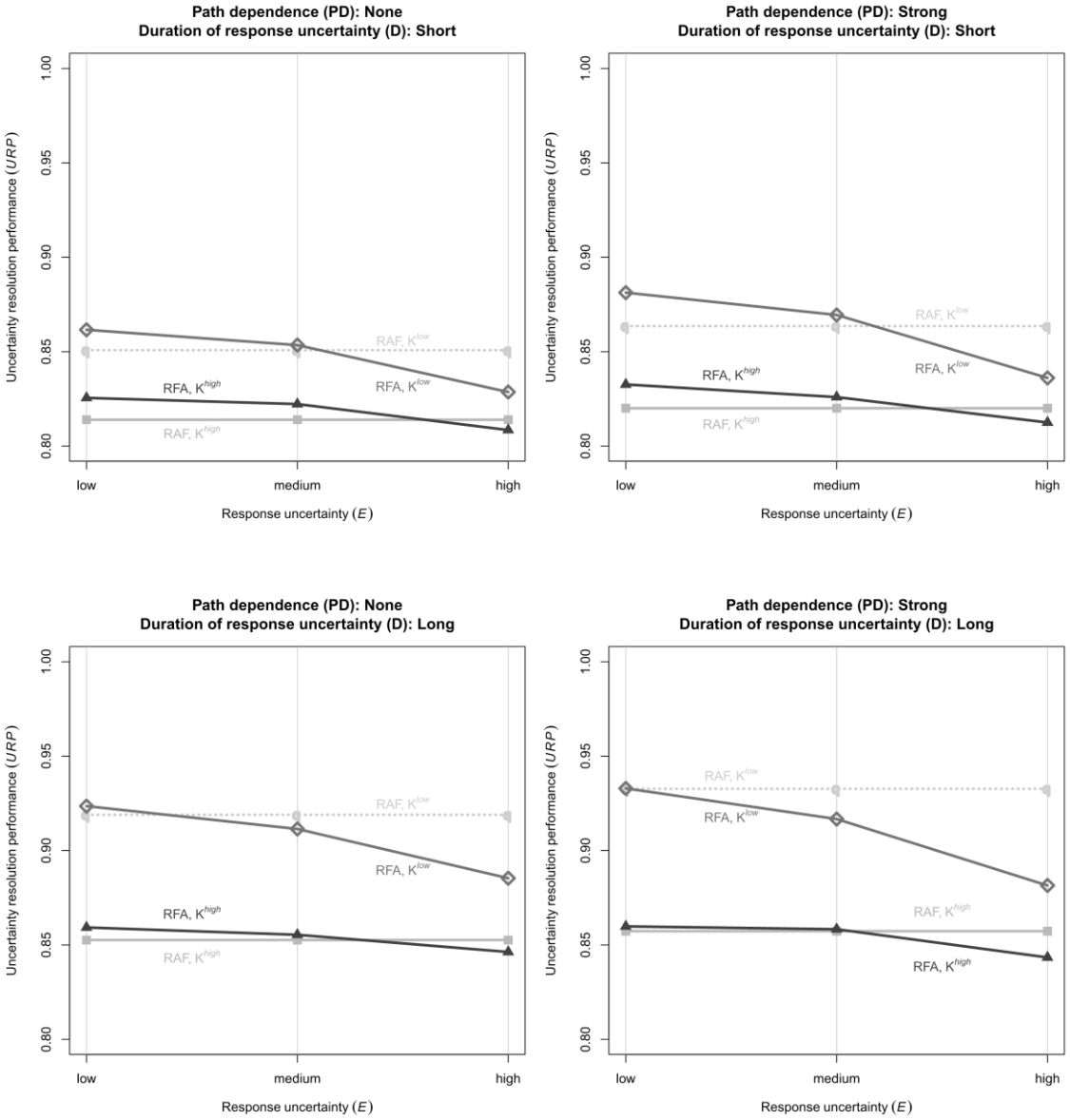
Uncertainty Resolution Performance (URP). URP depicts how quickly firms have been able to minimize the negative effects of a disruption on their performance (fitness value) at the point of time where response uncertainty has completely been resolved (either period 46 or 51). From then on, the firms face undistorted fitness values.

Figure 12 shows the URPs observed in our simulation experiments. One of the main insights from Figure 12 is that in highly complex environments RFA leads to a greater (or at least equal) URP than RAF if response uncertainty is low or medium. In highly

complex environments with high and long-lasting response uncertainty, RAF leads to a greater URP than RFA. When response uncertainty is low or medium and short-lived, RFA achieves a better URP than RAF, independent of the complexity of the firms' environment or the intensity of path dependence. Accordingly, we propose the following:

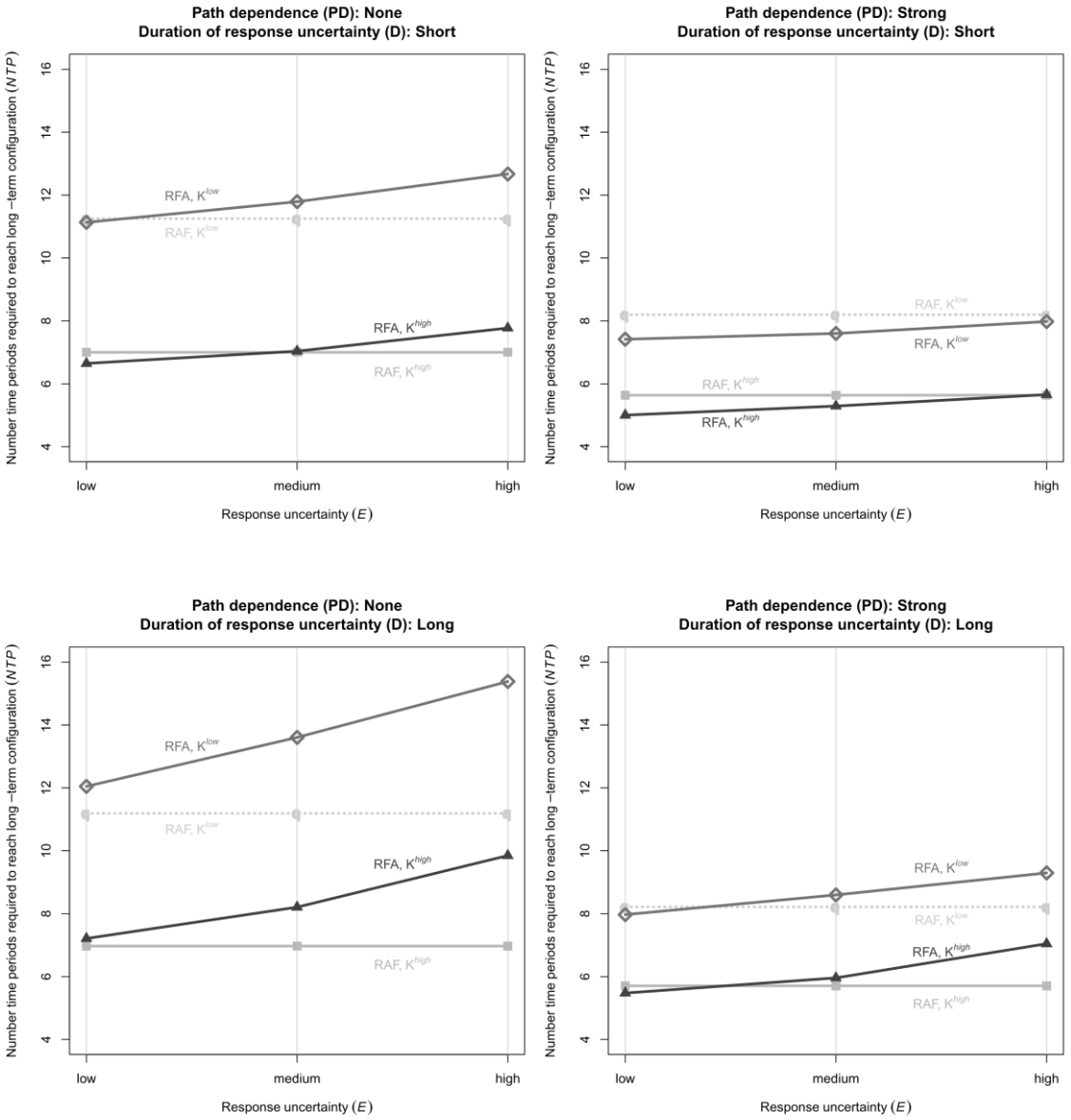
Proposition 6. *If the environment is highly complex and response uncertainty is low or medium, then* $URP_{RFA} \geq URP_{RAF}$.

Figure 12: Uncertainty resolution performance (URP)



Number of Time Periods Required to Reach the Long-Term Configuration (NTP). As a further measure of recovery process speed, we investigate how quickly firms recover.

Figure 13: Number of time periods required to reach long-term configuration (NTP)



To this end, the average number of time periods needed to reach a stable long-term configuration is calculated. Figure 13 depicts the NTP that firms applying one of the response strategies require to find their long-term configuration, subsequent to a supply disruption. In settings where actions are reversible and response uncertainty is long-lasting, RAF will be faster than (or at least as fast) RFA in reaching the long-term solution. However, if actions are irreversible, RFA leads to a more quickly completed recovery if response uncertainty is only low or medium and short-lived. This leads to the following and last propositions:

Proposition 7. *If actions are irreversible and response uncertainty is neither high nor long-lasting, then* $NTP_{RFA} < NTP_{RAF}$.

Proposition 8. *If actions are reversible and response uncertainty is medium or high, then* $NTP_{RAF} < NTP_{RFA}$.

4.3.8 Robustness of simulation results

To ensure that the results obtained were not due to chance, we performed several checks in congruence with previous studies using the NK model. First, the representativeness of the results was ensured by conducting 10,000 replications for every combination of *K*, *D*, *E*, and *PD* to eliminate the influence of random fluctuations in the generation of firms and environments. Every time we report a performance difference between the two response strategies, this difference in means is statistically significant with $p < 0.05$ or better. Second, we systematically varied all of the model parameters. To be as clear and concise as possible, we have presented only a subset of the results of all these simulation experiments. We focused on polar types of parameter values to be able to identify a parameter's influence. Although the precise quantitative outcomes change, the qualitative patterns can also be observed with intermediate values of the model parameters *K*, *D*, *E*, and *PD*. We find that most of the results that we report for highly complex environments (see P1, P4, P5, and P6) also hold if *K* equals 4. All other results hold for all values of *K*. Furthermore, the results we report for settings with irreversible actions (see P2, P5, and P7) hold for values of $PD > 0$. Increasing the number of decisions *N* does not qualitatively change the results. Third, the results are not sensitive to the assumption of similar initial configurations for the two agents in every simulation run. The same qualitative patterns also result from unequal initial configurations.

4.3.9 Discussion

By means of simulation experiments, we investigated under which conditions managers should delay their response actions until they have acquired more evidence on the consequences of response actions. The propositions derived are robust in many regards and yield several general insights. In the following, we focus on the insights generated for highly complex environments. We assume them to resemble today's business environments more accurately than less complex environments.

First, an immediate response to supply disruptions is beneficial for the average post-disruption performance even if the consequences of response actions cannot be

determined precisely. This holds true even if more than half of the decisions are irreversible and response uncertainty is long-lasting. Only if the latter becomes very high so that managers are virtually "poking around in the dark", firms should delay action until further information has been collected.

Second, the choice of a response strategy significantly affects the average long-term performance of firms. Moreover, if actions are reversible, firms pursuing RFA benefit from a high level of response uncertainty. This seems to be quite counterintuitive. However, one explanation for this result might be that high levels of response uncertainty drive exploration and testing of configurations which may turn out to be detrimental in the short-run but enable firms to achieve superior performance in the long-run. Hence, early decisions with an adverse effect on a firm's performance can provide an opportunity for future local improvements if actions are reversible. If detrimental initial decisions cannot be reversed, they pose a burden that a firm cannot recover from.

Third, although immediate action subsequent to a supply disruption requires more changes to find a stable long-term configuration, firms recover more quickly if response uncertainty is neither high nor long-lasting. This means that if firms are capable of quickly improving their ability to predict the consequences of their response actions, they benefit from a quick reaction and recover faster than competitors that might delay action to spend further resources on information collection.

4.4 How managers actually intend to behave in supply disruption response situations

To complement the findings from the simulation experiments, we use a vignette-based experimental methodology to analyze the behavior of managers in disruption recovery processes in business-to-business (B2B) contexts. Vignette-based experiments offer several methodological advantages which fit our specific research context. First, they provide controlled tests of causal relationships by carefully manipulating vignettes that are presented to the participants. Second, in comparison to rather retrospective studies based on surveys or case studies, the use of vignette-based experiments can generate more reliable data on respondent behavior, because participants have to indicate their intentions shortly after reading a specific scenario to minimize retrospective bias (Wathne et al., 2001). Third, an experimental design enables researchers to study behavior and choices where individuals or firms are usually not likely to share information (Rungtusanatham

et al., 2011). A supply chain disruption, which is our studied context, is typically accompanied by adverse effects on firms. Furthermore, severe incidents are rather rare and it would be unethical to actually disrupt a firm to collect data. Vignette-based experiments help to overcome both issues.

A vignette is defined as "short, carefully constructed description of a person, object, or situation, representing a systematic combination of characteristics" (Atzmüller & Steiner, 2010, p. 128). In our experiment, we integrate vignettes into a survey, since this is a promising but rarely applied approach to study respondents' judgments and account for each approach's shortcoming. By randomly assigning participants to treatment cells we eliminate systematic differences in the participants that might affect their responses (e.g., Bachrach & Bendoly, 2011). Hence, differences in response behavior can be attributed to the manipulated experimental treatments. This methodological approach has recently been employed in the field of operations management to study "chain liability" (Hartmann & Moeller, 2014), make-or-buy decisions (Mantel et al., 2006), observational learning (Hora & Klassen, 2013), and perceptual differences between buyers and suppliers (Ro et al., 2016).

4.4.1 Development of the vignettes

A key aspect of vignette-based experiments is the vignette design and validation. We carefully constructed vignettes that assigned participants to the role of a procurement manager that faces a supply disruption and considers to take immediate action to mitigate its negative consequences. We followed the principle of form postponement, hence, all vignettes began with an introductory *common module* that was the same for all participants to ensure the provision of a similar contextual background (Aguinis & Bradley, 2014; Rungtusanatham et al., 2011). Our three factors of interest, response uncertainty, complexity, and path dependence, were manipulated in a subsequent *experimental cues module*. We developed a scenario of a supply disruption involving a supplier that is unable to ramp up production and deliver large enough amounts of its product (electric engines) as an example of a disruption that frequently occurs in practice (e.g., Hepher & Altmeyer, 2017; D. Wu & Ting-Fang, 2017). All other factors of the vignettes were held constant.

Our factors of interest were manipulated in line with the parameters and their levels shaping the model developed in the third section to be able to depict comparable

scenarios. To maintain an adequate degree of complexity for the participants, we restricted the experiment to a static one-shot decision, focused on low and high levels of response uncertainty, and abstained from including duration of response uncertainty as a further factor. In total, using a 2 (response uncertainty: *Low* or *high*) x 2 (complexity: *Low* or *high*) x 2 (path dependence: *None* or *strong*) full factorial design, we created eight vignettes. After reading a vignette, participants were asked to imagine themselves in the role of the procurement manager in the described scenario and indicate their willingness to take immediate action. We utilized a form of indirect questioning (projective technique) to limit potential demand characteristics and effects of social desirability (Thomas et al., 2013). In addition, respondents were supposed to report their risk attitude. In order to measure the latter, we employed the general risk question (Dohmen et al., 2011) which is widely used and requires participants to rate their individual willingness to take risks on a 11-point Likert-type scale. It has been shown to be a very good predictor of risk-related behavior.

Two different levels of response uncertainty were described by varying how uncertain it was that the proposed action positively influenced the depicted supply disruption's negative consequences. It was either *quite certain* (low) or *very uncertain* (high) that the consequences of taking action could be predicted. Complexity was varied by manipulating the independence of the decision. In the low complexity setting, the decision needed to be taken in a *slightly complex* environment with *minor* impact on other internal processes and its success was *almost independent* of the actions of colleagues. In the high complexity setting, the decision needed to be taken in a *very complex* environment with a *very large* impact on other internal processes and its success was *very much dependent* on the actions of colleagues. Path dependence was manipulated by varying the extent to which future options were limited by the decision to immediately act or not. They were either *not* (none) or *heavily* (strong) limited.

As recommended by Wason et al. (2002), the vignettes were pre-tested with 85 students that were randomly assigned to one of the eight treatment condition to assess the vignettes' validity, internal consistency, and realism. After reading the vignettes, students were asked to indicate their willingness to act and responded to manipulation checks to ensure that different levels of the independent variables were appropriately represented. Average responses for complexity and path dependence were significantly different between low and high treatment groups. We included three levels of response uncertainty

in our pretest (*Low*, *medium*, and *high*), however, there were no significant differences between medium and high response uncertainty. In order to address this shortcoming and reduce the complexity for our participants, we focused on low and high levels of response uncertainty in the final experiment. The students also rated the realism for the scenario description on a seven-point scale (1 = "not at all" to 7 = "totally"). The vignettes appeared realistic with mean responses ranging from 4.50 to 6.29 (grand mean is 5.61).

4.4.2 Study participants

Data were collected by means of a self-administered online experiment. Between June and September 2017, 1056 managers with direct experience in supply chain management from Germany, Austria, and Switzerland, have been invited to participate in our experiment. Contact addresses were obtained from a commercial business data provider. The managers received an invitation via e-mail and were randomly assigned to one of the eight treatment conditions. 112 of them completed the experiment, resulting in an effective response rate of 10.61%. On average, participants had almost 18 years of experience in supply chain management (*SD* = 10.33). Two observations were dropped due to outlier analysis, resulting in 110 usable vignettes.

4.4.3 Dependent variable

By means of our vignette experiments, we aim to reveal how response uncertainty, complexity, and path dependence affect the intentions of managers to take immediate action in response to supply disruptions. The decision to take immediate action can be seen as being binary, however, binary outcomes provide only little variance to explain and understand the effects of response uncertainty, complexity, and path dependence on such decisions. We follow McKelvie et al. (2011) and Cantor, Blackhurst, and Cortes (2014) by operationalizing our dependent variable as the participant's *intention to take immediate action* (ITA), on a nine-point scale (anchored at 1 := "not at all likely" to 9 := "totally likely"). The specific action to be considered is described in detail in each vignette.

4.4.4 Manipulation checks

As in the pre-test, we verified that each participant perceived differences in our manipulations of the independent variables, as intended. To this end, all participants were

asked to respond to several manipulation checks, on seven-point scales (1 := "not at all" to 7 := "totally"), after reading and responding to a vignette. To assess the perceived level of response uncertainty, participants were asked to indicate to which extent they agree that the consequences of the proposed action were very uncertain. The respondents' perception of low and high levels of response uncertainty were significantly different (M_{low} = 2.61, M_{high} = 5.92; $t(108)$, $p < 0.001$). To validate the manipulation of complexity, we asked participants to evaluate whether the decision had to be taken in a very complex environment. The participants' responses were significantly different for low and high levels of complexity (M_{low} = 1.85, M_{high} = 6.04; $t(108)$, $p < 0.001$). Finally, to check whether the two levels of path dependence were perceived to be different, participants rated to which extent they agree that the depicted decision limited future opportunities to a very large extent. Respondents reported higher degrees of agreement when path dependence was strong compared to when it was absent (M_{none} = 2.17, M_{strong} = 5.49; $t(108)$, $p < 0.001$).

4.4.5 Results

We relied on analysis of variance (ANOVA) to dissect our participants' intentions. Parametric tests (e.g., ANOVA) are appropriate and robust for Likert-type data and can be used with "small sample sizes, with unequal variances, and with non-normal distributions, with no fear of 'coming to the wrong conclusion'" (Norman, 2010, p. 631). A three-way ANOVA with response uncertainty (low or high), complexity (low or high), and path dependence (none or strong) as between-subjects factors and ITA as dependent variable was conducted. Table 12 contains information on the number of participants per cell, cell means, and corresponding standard deviations for our dependent variable ITA.

The results revealed significant main effects of response uncertainty (F = 25.07, $p < 0.001$), complexity (F = 17.19, $p < 0.001$), and path dependence (F = 4.77, p = 0.03) on ITA. Low response uncertainty led to higher levels of ITA (M_{low} = 5.02, SD = 2.60) than high response uncertainty (M_{high} = 2.94, SD = 1.91). The low complexity treatment revealed higher levels of ITA (M_{low} = 5.00, SD = 2.46) than the high complexity treatment (M_{high} = 3.14, SD = 2.24). Finally, the absence of path dependence resulted in a higher willingness to take immediate action (M_{none} = 4.58, SD = 2.53) than its presence (M_{strong} = 3.56, SD = 2.43). No statistically significant interaction effects between these three

variables were identified. ANOVA results are provided in Table 13 and Figure 14 depicts the analyzed main effects.

Table 12: Frequencies, cell means, and standard distributions for ITA

Experimental condition			Intention to take immediate action (*ITA*)		Number of observations (n = 110)
Path dependence	**Complexity**	**Response uncertainty**	***M***	***SD***	
None	Low	Low	6.88	1.75	16
		High	3.92	2.02	12
	High	Low	4.33	2.61	12
		High	2.62	1.50	13
Strong	Low	Low	5.29	2.09	14
		High	3.25	2.42	12
	High	Low	3.53	2.67	17
		High	2.14	1.35	14

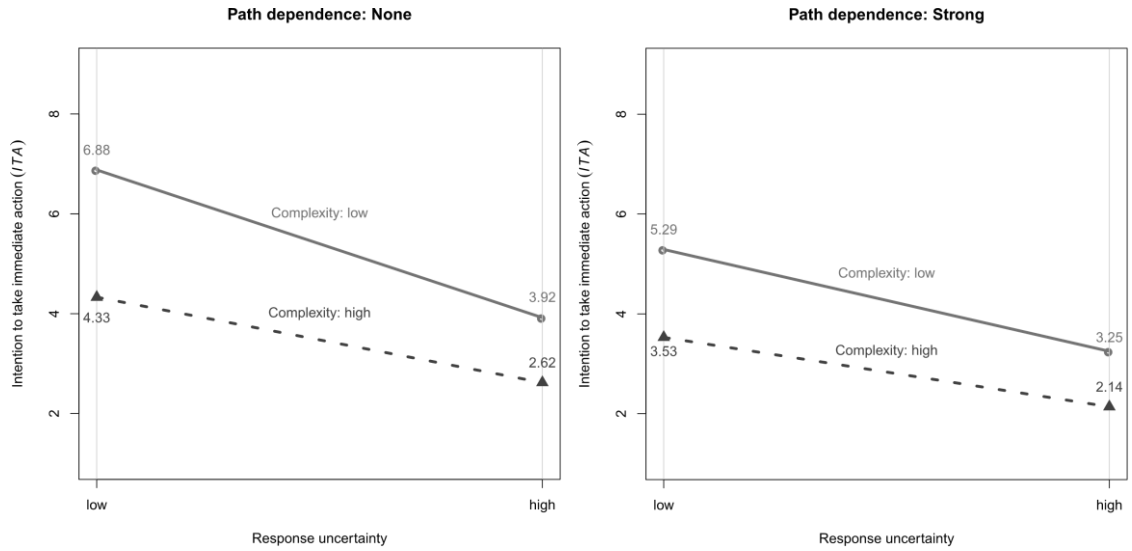
Table 13: ANOVA results

Source	Partial *SS*	*df*	*MS*	*F*	*p*-value
Response uncertainty	110.96	1	110.96	25.07	0.000 ***
Complexity	76.09	1	76.09	17.19	0.000 ***
Path dependence	21.11	1	21.11	4.77	0.031 *
Response uncertainty × Complexity	6.04	1	6.04	1.36	0.246
Response uncertainty × Path dependence	2.66	1	2.66	0.60	0.440
Complexity × Path dependence	1.62	1	1.62	0.37	0.546
Response uncertainty × Complexity × Path dependence	0.59	1	0.59	0.13	0.716
Model	240.21	7	34.32	7.75	0.000 ***
Residual	451.47	102	4.43		

Note. n = 110. The dependent variable is "intention to take immediate action" (*ITA*). *SS* refers to "sum of squares" (Type III), *df* to "degrees of freedom", and *MS* to "mean square".
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

To examine the robustness of our findings and to ensure that the participants' intentions were not determined by their experience and risk attitude, we included both variables as covariates in an analysis of covariance (ANCOVA) with ITA as dependent variable and response uncertainty, complexity, and path dependence as independent variables. Neither the experience nor the risk attitude of the participating individuals had a statistically significant influence on ITA. Hence, the predicted effects remained qualitatively similar.

Figure 14: The effects of response uncertainty, complexity, and path dependence on ITA



4.4.6 Discussion

The depicted results provide insights into the intentions of managers to take immediate action after being hit by a supply disruption. The carefully designed vignette experiment reveals that the main parameters of our supply disruption recovery model, namely response uncertainty, complexity, and path dependence, considerably affect actual decision making within disruption management. Furthermore, we find that the effects of these influencing factors on managers' willingness to take immediate action do not interact with each other which enables straightforward interpretation.

More specifically, we demonstrate that, as response uncertainty and path dependence increase, managers are less willing to take immediate action. This means that, with regard to these two influencing factors, managers' intentions basically correspond with how they should behave according to the simulation experiments. However, the results also demonstrate that higher levels of complexity seem to inhibit quick responses, which contradicts the insights drawn from the simulation experiments. The latter suggest that, as complexity increases, immediate action becomes more beneficial and should be preferred to delaying action if response uncertainty is not high. In contrast, our participants generally reveal lower levels of their willingness to take immediate action. This is in line with prior research, which states that decision makers will prefer to delay action, seek new alternatives, or revert to the status quo as the choice environment

becomes complex (Dhar, 1997). However, we thereby identify and provide empirical support for an important mismatch between how managers should behave and how they actually intend to act.

4.5 General discussion

Recovering from supply disruptions is a challenging task for the responsible managers. Typically, the subsequent decision making process is characterized by response uncertainty, complexity, and path dependence. Response uncertainty results from a lack of being able to precisely predict the consequences of response alternatives, complexity is driven by interactions among decisions, and path dependence stems from considerable expenditures required to change the operational setting of a firm. Against this backdrop, our multi-method study contributes to the emerging literature on supply disruption management by (1) providing insights into disruption recovery processes, (2) clearly defining RAF and RFA and delineating their implications for the recovery performance of firms by providing testable propositions, (3) revealing actual intentions of managers regarding their willingness to take immediate action in response to supply disruptions, and (4) considering distorted performance evaluations in the NK model by incorporating uncertainty.

4.5.1 Implications for research

This research analyzes the conditions under which a firm should decide to delay the initial recovery action to a point where more accurate information has been accumulated and investigates how managers actually intend to act. In this context, we have identified two archetypical approaches of organizational decision making: RAF and RFA. The former characterizes firms that tend to collect further information before taking action in the hopes of being able to make better informed decisions by eliminating response uncertainty. This means that analysis precedes and enables action. Thus, RAF resembles the rather rational approach to problem solving, similar to what one of the procurement executives that we interviewed explained: "*Discovery, then we collected information.* […] *Then you consider, what can you do? You develop options and alternatives. Afterwards you try to decide which one can be applied. Then, implementation and monitoring.*"

RFA represents firms that respond immediately to a supply disruption, even if response uncertainty is present. Procurement executives stated the following when asked about their response to supply disruptions: "*We immediately started bottleneck-management, before we exactly knew how the situation really is*", "*acting started immediately after the discovery*", and that they "*did not initially build large teams to discuss it, we rather needed to act very quickly*." Based on imprecise or incomplete information on the consequences of response alternatives, they took action to be able to observe results that enable further adjustment. One respondent described such a process: "*We tried to find short-term solutions first. We took action and when we* […] *did not reach the performance that was supposed to be reached, we decided to take another path*." Following Weick's (1979) idea, these firms emphasize the use of action to make sense of observable outcomes. Thus, action is assumed to clarify the situation and create meaningful insights to guide and enable subsequent decisions.

Table 14: Summary of propositions

P1	*If the environment is highly complex and actions are reversible, then* $PDP_{RFA} > PDP_{RAF}$.
P2	*If the environment is highly complex, actions are irreversible, and response uncertainty is low or medium, then* $PDP_{RFA} > PDP_{RAF}$.
P3	*If actions are reversible, then* $FP_{RFA} \geq FP_{RAF}$.
P4	*If the environment is highly complex and actions are reversible, then* FP_{RFA} *increases with the level and the duration of response uncertainty*.
P5	*If the environment is highly complex, actions are irreversible, and response uncertainty is high, then* $FP_{RAF} > FP_{RFA}$.
P6	*If the environment is highly complex and response uncertainty is low or medium, then* $URP_{RFA} \geq URP_{RAF}$.
P7	*If actions are irreversible and response uncertainty is neither high nor long-lasting, then* $NTP_{RFA} < NTP_{RAF}$.
P8	*If actions are reversible and response uncertainty is medium or high, then* $NTP_{RAF} < NTP_{RFA}$.

Different authors have advocated either RAF (e.g., Kepner & Tregoe, 1965) or RFA (e.g., Peters & Waterman, 1982), but the implications of both approaches on a firm's disruption recovery performance in complex settings accompanied by response uncertainty and path dependence have not yet been examined. The findings of our simulation experiments, summarized in eight testable propositions shown in Table 14, address this important research gap. Obviously, firms that apply RFA are exposed to the risk of erroneously altering their operating procedures in the belief that the change will lead to better firm performance. Although the expected performance of an alternative configuration might be greater than the performance of the current configuration, the true performance might be reduced, because the performance values of alternative

configurations are distorted by response uncertainty in the early stages of a recovery process.

In line with the insights provided in the third section, we furthermore demonstrate that response uncertainty and path dependence reduce the actual willingness of managers to take immediate action. However, higher levels of complexity have a similar effect, although managers should actually respond quickly to supply disruptions in complex environment if response uncertainty is not high. This circumstance illustrates a considerable mismatch between managers' intentions and their optimal behavior according to our findings. Moreover, we do not find evidence for an action bias in post supply disruption decision making (Bar-Eli, Azar, Ritov, Keidar-Levin, & Schein, 2007). On the contrary, managers react sensitively to high levels of response uncertainty, complexity, and path dependence and reduce their willingness to take immediate action.

4.5.2 Implications for practice

In addition to the theoretical implications discussed above, the results of our research also have important implications for practice. Managers responding to supply disruptions need to be aware of the conditions that characterize their environment. The level of response uncertainty that firms face considerably affects the ramifications of delaying action or immediately responding to a supply disruption. In complex environments, only if response uncertainty is perceived to be high and long-lasting, waiting for more information can be advisable, based on our results. Furthermore, managers are required to trade off the accuracy of their actions against the speed of their reaction. On the one hand, delaying a response results in more precise first improvements and requires less changes to be made. On the other hand, immediate responses on average result in quicker recovery of firm performance. Moreover, the long-term performance of firms is, on average, not weakened but rather strengthened by response uncertainty if detrimental decisions can be reversed. In complex environments, firms may also benefit from quick responses in the short run and may increase their market share as Nokia did in did in the aftermath of the aforementioned disruption.

Furthermore, previous research on decision making behavior highlighted the influence of cognitive biases on the decision to act or not to act. Managers should be aware of these biases to avoid being misled in their decision of when to respond to a supply disruption. Some decision makers tend to be biased towards analysis (Kerstholt,

1996). A tendency for RAF can, for example, even be fostered by a status-quo bias (Samuelson & Zeckhauser, 1988). This bias represents the tendency in human decision making under uncertainty to value the current state more than a potentially superior but uncertain alternative. In the worst case, this may lead to the phenomenon of analysis paralysis meaning that action is delayed further and further. Similarly, a tendency for RFA is intensified by an action bias. If managers take action, "at least they will be able to say that they tried to do something" (Bar-Eli et al., 2007, p. 616). Furthermore, action is considered more appropriate than inaction in response to bad performance (Zeelenberg, Van den Bos, Van Dijk, & Pieters, 2002). Hence, taking action might often appear to be an attractive option for managers although they should rather delay a response.

Surprisingly, based on the results of the vignette-based experiments, we are able to demonstrate that managers tend to refrain from taking immediate action if the degree of either response uncertainty, complexity, or path dependence increase. However, managers should rather take immediate action in complex environments, as delineated by our simulation experiments. This incongruity has important practical implications for the management of supply disruptions. Managers seem not to be aware of the benefits associated with quick responses in complex decision making environments and should demonstrate a higher willingness to take immediate action when exposed to complexity.

4.5.3 Limitations and future research opportunities

The contribution of this research is constrained by several limitations. As a main assumption of the NK model and the model developed in the third section, each decision *i* is assumed to interact with exactly the same number of decisions as every other decision. Nevertheless, some decisions might actually interact with more of the other decisions than others do. Furthermore, we have limited our model to decision makers with centralized authority, because we assumed that this is a basic characteristic of disruption management processes. We did not consider many factors that might also characterize organizational search processes such as the presence of a hierarchy (Mihm et al., 2010) and the need to coordinate (Lounamaa & March, 1987). In addition, we assumed that a supply disruption does not change the underlying complexity of an environment. However, it might be possible that a severe supply disruption alters the level of interaction between the operational activities of a firm. Another limitation concerns our conceptualization of performance. Although we refer to a firm's operating performance as main determinant

of a firm's recovery efforts, our model's measure of operating performance is abstract rather than specific.

Moreover, although complementing the simulation experiments, the vignette-based experiments introduces further limitations. First and foremost, the participants were exposed to vignettes containing information about a specific one-shot supply disruption situation. In real disruption recovery processes, subjects are likely to receive such information in a more fragmented fashion, perhaps over multiple time periods. In order to reduce the complexity of the decision making task for our respondents, we refrained from a multi-stage setting taking, e.g., the duration of response uncertainty into account. Thus, research accounting for the dynamics of disruption recovery processes would add to the validity and generalizability of our findings. In addition, we rely on the intentions of managers instead of their actual behavior. However, prior research shows that intentions may serve as reliable indicators of actual behavior (e.g., Ajzen, 1991; T. L. Webb & Sheeran, 2006).

Finally, our work suggests several opportunities for further research. The delineated and defined disruption response strategies RAF and RFA could be empirically investigated through large-scale studies or further (dynamic) experiments. The developed propositions could be used to derive testable hypotheses on the performance of RAF and RFA. Moreover, our research indicates that the use of the NK model can provide rich insights into the management of supply disruptions. The NK framework will remain a powerful tool to analyze organizational decision making under complexity that does not allow for analytical optimization. Future research could build on our suggestions on how to represent supply disruption recovery and apply the NK model methodology to further research questions of the field by adjusting or extending our model. In addition, our research demonstrates the importance and relevance of behavioral aspects in the supply (chain) disruption context and the need to further investigate disruption management processes, typically characterized by limited time and unreliable or sparse information. Therefore, we hope that this work encourages further research on supply disruption management. Given the fact that firms will most likely never be able to fully control their environment and perfectly predict changes, managers will continue to face severe supply disruptions and require additional insights on how best to respond to them.

Chapter 5 Conclusion and future research directions

This chapter summarizes the research delineated in the previous chapters and highlights the main answers to the research questions formulated in Chapter 1. In addition, the main limitations of this dissertation research and avenues for future research are discussed.

5.1 Summary

The extant research has focused on supply risk and disruption management from a firm perspective, however, a firm's responsible decision makers play a key role in addressing supply risk and disruptions. In the first chapter of this dissertation, three important but yet unclear behavioral issues have been identified in this context. They have been addressed by the studies presented in Chapters 2, 3, and 4. Their results are summarized in the following.

5.1.1 Research question 1: Supply risk management

The increasing complexity and interconnectedness of modern supply chains have added to the vulnerability of many firms to suffer from supply disruptions. Although most supply chain managers are well-aware of their potentially severe negative consequences, recent major disruptions have revealed that many supply chain managers prove unprepared to effectively recover their firms' operational performance (A.T. Kearney & RapidRatings, 2018). Given that there is a need to better understand why some managers proactively prepare for supply disruptions and others do not, Research Question 1 was formulated.

To provide answers to Research Question 1, the research presented in Chapter 2 builds on PMT and its underlying idea of cognitive appraisal processes that determine an individual's intention to adopt a specific proactive measure. In addition, based on a framework delineating key antecedents of proactive work behavior developed by Frese and Fay (2001), this research accounts for the effects of certain individual-specific factors on proactivity. By means of a carefully designed DCE, empirical data were collected to explore the choice behavior of supply chain managers in the context of supply risk management and evaluate the developed propositions. The data enabled an assessment of

the relative importance of certain proactive action attributes and a comparison of choice behavior with the perceptions of the participants.

In line with the coping appraisal process of PMT, the DCE explored the relative importance of (1) a specific proactive measure's effectiveness (response efficacy), (2) an individual's ability to successfully implement the measure (self-efficacy), and (3) the costs associated with pursuing the proactive measure (response costs). An analysis of the results showed that all of these factors have significantly influenced the probability to choose a specific proactive measure. Surprisingly, the effectiveness of a proactive measure emerged as least important factor. When selecting proactive measures, response costs (we distinguished between the following response costs: Direct implementation costs and negative side effects on the respective buyer-supplier relationship) were subconsciously given more importance than self-efficacy or response efficacy. However, high vulnerability to a supply disruption mitigated the relative importance of response costs.

A comparison of the subconsciously assigned weights with the consciously rated perceived importance of these proactive action attributes unveiled a considerable mismatch between decision makers' perceptions and their choice behavior in the context of supply risk management. While response efficacy was subconsciously assigned least importance in the DCE, it was prioritized over response costs and self-efficacy when the supply chain managers were asked to directly rate the relative importance of proactive action attributes.

Further implications with regard to Research Question 1 were derived from the influence of individual-specific factors on choice behavior. An individual's proactive personality, risk attitude, control appraisal, and experience had statistically significant effects on the relative importance of the included proactive action attributes. These effects shed light on what drives decision makers to or prevents them from selecting specific proactive actions and the related insights were incorporated into an enriched model of PMT that accounts for the influence of individual-specific factors on building protection motivation (see Figure 5).

In sum, study 1 adds to a better understanding of why, in the supply risk context, some managers take proactive action while others do not. This is an important contribution as this is the first attempt to analyze choice behavior to derive insights into

proactive decision making in supply risk management. Moreover, several promising opportunities for future research have been identified and discussed.

5.1.2 Research question 2: The influence of supply risk management on the impact of disruptions

Although the topic of CSR has received considerable attention in business practice and research, it is often merely associated with "doing good" while "avoiding bad" and, more specifically, the issue of CSIR, have largely been neglected. In light of this, many firms engage in CSR in the hopes of "insurance-like" effects in case of environmental or social misconduct. However, the effects of ex ante CSR on negative stakeholder reactions subsequent to CSIR are not fully understood. Thus, study 2 in Chapter 3 was concerned with Research Question 2.

Two conflicting perspectives on the effect of a firm's prior CSR activities on negative stakeholder reactions to CSIR emanate from prior literature. On the one hand, some studies have theorized an insurance-like mechanism such that prior CSR engagement builds a "reservoir of goodwill" that mitigates negative responses to bad news (e.g., Flammer, 2013; Godfrey et al., 2009). On the other hand, additional research efforts conclude that firms which engage in CSR might create an expectation burden in case of severe CSIR since these firms are often criticized the most (e.g., Swaen & Vanhamme, 2003; Vanhamme & Grobben, 2009). To better understand whether these effects depend on CSIR severity and the CSR reputation's nature, study 2 presents and discusses the results of a vignette-based experiment.

These results provide further empirical support for the circumstance that insurance-like effects of CSR do not always hold and contribute to specifying their relevant boundary conditions. Both CSIR severity and the CSR reputation's nature (substantive/ symbolic) moderate the relationship between CSIR and negative stakeholder reactions. Based on study 2, it can be concluded that substantive CSR reputations provide insurance-like benefits in case of less severe CSIR but do not seem to mitigate negative stakeholder reactions to severe CSIR. However, firms with reputations mainly driven by symbolic CSR also experience insurance-like effects in response to less severe CSIR, but are exposed to higher intentions to engage in nWOM after severe CSIR compared to firms that did not promote themselves as socially responsible.

Being the first study that explicitly addressed the role of ex ante CSR reputations on negative stakeholder reactions to CSIR in a B2B environment, the results contribute to an improved understanding of CSIR-related risk and disruption management. In addition, this study provides valuable empirical support for CSR engagement based on instrumental rather than moral motives.

5.1.3 Research question 3: Supply disruption management

Supply disruptions pose considerable challenges to managers that seek to recover from their negative consequences. After being exposed to supply disruptions, managers typically face unreliable information about the consequences of possible response actions. In this context, it is not trivial to decide on whether to wait until more reliable information are available or directly launch response actions. Hence, to gain a better understanding of how to effectively respond to supply disruptions, the research presented in Chapter 4 has addressed Research Question 3 by means of a multi-method approach.

In a first step, simulation experiments with an agent-based model of supply disruption recovery revealed how managers should behave in response to supply disruptions. The model was developed based on complexity, response uncertainty, and path dependence as main determinants of a supply chain manager's environment in the aftermath of a supply disruption. The results highlight that high complexity favors quick action to be able to make sense of observable outcomes, but if response uncertainty is high, more reliable information should be acquired before action is taken. Further key insights were summarized in eight testable propositions which provide promising opportunities for future research.

In a second step, the actual willingness of managers to take immediate action subsequent to being affected by a supply disruption was explored. An analysis of data from vignette-based experiments showed that response uncertainty and path dependence reduced the participants' intention to quickly respond to supply disruptions. Moreover, although managers should actually respond quickly to supply disruptions in highly complex environments if response uncertainty is not high, the results reveal that managers tend to refrain from a quick response in case of high complexity. Hence, the multi-method approach enabled the identification of a considerable mismatch between managers' intentions and the recommended behavior based on the simulation experiments. Thereby, Study 3 contributes to the emerging literature on supply disruption recovery and adds to

a better understanding of decision making behavior in the context of supply disruption management.

5.2 Limitations

As with any empirical research, the results presented in this dissertation must be viewed in light of certain overarching limitations concerning the data and the research designs.

First, the behavioral experiments conducted in Study 1 (discrete choice), Study 2 (vignette-based), and Study 3 (vignette-based) rely on intentions instead of actual behavior as their outcome criteria. Stated intentions are considered the best predictors of actual behavior (Ajzen, 1991; T. L. Webb & Sheeran, 2006). However, research has shown that intentions are not perfectly correlated with future behavior, especially if there is a large time lapse between measuring intentions and behavior or if an individual is unable to act on an intention due to a lack of skills or unanticipated barriers (Fishbein, 2008; Morwitz, 1997). Hence, replicating the experiments with actual behavior as outcome variable would enhance the explanatory power of the results presented.

Second, this dissertation focusses on individuals with centralized decision making authority to investigate the behavior of purchasing professionals. Hence, the studies conducted did not account for certain characteristics of industrial buying situations such as hierarchical structures (W. J. Johnston & Bonoma, 1981), codes of conduct (Wotruba, Chonko, & Loe, 2001), and the need to coordinate with other functions (Kocabasoglu & Suresh, 2006). Thus, a worthwhile next step would be to develop research designs that incorporate these characteristics and more comprehensively examine decision making behavior in industrial buying situations.

Finally, the experiments with purchasing professionals conducted in Study 1, Study 2, and Study 3 mostly relied on respondents from German-speaking countries (Austria, Germany, and Switzerland) which have relatively similar cultures (Hofstede, 1984, 2003). Their responses were treated as a single data set in the statistical analyses, since previous research did not indicate any differences among these countries. However, it has been shown that culture may influence behavior (e.g., Money et al., 1998). In addition, the frequency and severity of natural disasters in Austria, Germany, and Switzerland are very low compared to other countries or regions (e.g., Asia or the US) (Helferich & Robert, 2002) which may have repercussions on the behavior of purchasing professionals.

Hence, replicating the experiments conducted as part of this dissertation research with respondents from other cultural regions or from countries with different risk profiles would be a promising next step to disentangle the influence of culture and environmental conditions on choice behavior in the context of supply risks and supply disruptions.

5.3 Outlook

In addition to addressing the limitations mentioned above, several fruitful avenues for future research in the area of supply risks and disruptions emerge from this dissertation research.

First, the model of supply disruption recovery presented in Study 3 could serve as a basis for further research on managing supply disruptions. Using an adjusted or extended version of the model might provide additional insights into decision making behavior of purchasing professionals. For example, although Study 3 focusses on whether to delay a response subsequent to supply disruptions, the model could be used to investigate the recovery performance implications of teams instead of single respondents or account for different organizational structures. Moreover, the simulation experiments in Study 3 have led to eight testable propositions which could be empirically investigated by means of large-scale studies or dynamic experiments.

Second, although this dissertation provides important contributions to the academic discussion on behavioral issues of managing supply risks and disruptions, many relevant questions remain unanswered. Despite the growing scholarly interest in individual level behavior in the supply risk literature, research on behavioral aspects of managing supply risks and disruptions is still scant especially in light of the fact that coping with supply risks poses several managerial challenges. Study 1 has highlighted that certain individual-specific factors affect proactive risk management decisions. However, it is likely that further personality-related factors, such as measures of ambition and extraversion, could also considerably impact the decisions of the responsible managers. In addition, the influence of an individual's cultural background or organizational codes of conduct on the behavior of purchasing professionals remain largely unclear. Given that many firms have considerably increased their degree of globalization during the last decades and comprise a multi-cultural set of employees, these issues might have important repercussions on decision making in supply risk and disruption management.

Finally, this dissertation research strongly relies on experiments as methodological approach to address the identified research questions. The studies' results contribute valuable insights into the behavior of purchasing professionals and, hence, highlight the unique advantages of using experiments to study behavioral issues of supply risk and disruption management such as control, efficiency, and responsiveness (Siemsen, 2011). Nevertheless, supply chain researchers have only begun to exploit these benefits to, for instance, augment or weaken the confidence in the validity of a theory by complementing results of surveys or archival research with insights from behavioral experiments. Thus, a promising avenue for future research on behavioral issues in supply risk and disruption management is the intensified and innovative use of experiments.

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Curriculum vitae

Academic employment

08/2017 – 10/2017 **Visiting Researcher**
Colorado State University, Fort Collins, Colorado, USA
on invitation by Dr. Lynn M. Shore and Dr. John R. Macdonald

08/2015 – 09/2018 **Doctoral Candidate/ Research Assistant**
University of Mannheim, Business School, Mannheim, Germany
Endowed Chair of Procurement

Education

08/2015 – 09/2018 **Doctoral Studies in Business Administration (Dr. rer. pol.)**
University of Mannheim, Business School, Mannheim, Germany
Thesis: ”Decision Making in Supply Risk and Supply Disruption Management”
Advisor: Prof. Dr. Christoph Bode

09/2013 – 07/2015 **M.Sc. in Mannheim Master in Management**
University of Mannheim, Business School, Mannheim, Germany

09/2012 – 01/2013 **ERASMUS Semester abroad**
NOVA School of Business and Economics, Lisbon, Portugal

10/2010 – 09/2013 **B.Sc. in Business Administration**
University of Cologne, Faculty of Management, Economics, and Social Sciences, Cologne, Germany