Organization's drive train: combining innovation assets, entrepreneurial actions, and communication strategies to maneuver through critical terrain

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by

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Summary

The importance of organizational resilience can be best demonstrated by considering the recent history and current times. In spring 2020, the COVID-19 pandemic hit the world, leading to human losses, economic shutdowns, distorted supply chains, puzzled governments, and improvising management teams. Two years later, when millions of infections and vaccinations allowed a transition back to normal, the Russian invasion of Ukraine made energy and food prices rise, global supply chains collapse, and companies cease business activities in Russia. The fear of new risks impacting the globe remains high (World Economic Forum, 2022) and forces firms of all sizes to manage current crises and, more importantly, make provisions for the challenges to come. The latter is the core of organizational resilience and the theme of this dissertation (Hillmann & Guenther, 2021).

Academic literature seeks to provide guidance and notices an increase in crisis management and resilience-building articles, but it still lacks a comprehensive understanding of antecedents and contingencies (Linnenluecke, 2017). A large body of existing research focuses on the isolated influence of firm performance (e.g., Brown and Petersen (2015); Ferrando, Marchica, and Mura (2017); Medrano and Olarte-Pascual (2016)), strategic orientation (e.g., Frösén and Tikkanen (2016); Holtermann, Hundt, Steeger, and Bersch (2021); Tognazzo, Gubitta, and Favaron (2016)), or the management team (e.g., Battisti, Beynon, Pickernell, and Deakins (2019); Buyl, Boone, and Wade (2019); Sajko, Boone, and Buyl (2020)). Contingencies receive little attention but are typically of a firm-specific or macroeconomic character, e.g., related to firm size (Bartz & Winkler, 2016; Rauch, Wiklund, Lumpkin, & Frese, 2009; Yoshikuni & Albertin, 2018), business environment (Lumpkin & Dess, 2001; Walrave, Romme, van Oorschot, & Langerak, 2017), or the economic cycle (Frösén & Tikkanen, 2016; Shakina & Barajas, 2016). Both conceptualization and operationalization of organizational resilience are relatively flat and often focused on a few repeating statistical approaches. These include sales growth (e.g., Bartz and Winkler (2016); Mudambi and Swift (2011)), return on assets (e.g.,

Minichilli, Brogi, and Calabrò (2016); Salvato, Sargiacomo, Amore, and Minichilli (2020)), and profitability (e.g., Srinivasan, Lilien, and Sridhar (2011); Walrave et al. (2017)).

In aspiration of identifying resilience-building factors that generate a dual benefit, i.e., positive contributions in both stable and unstable times, this academic work focuses on the topics of innovation and entrepreneurship. As such, my dissertation builds on the positive relationship both have on firm performance (e.g., Adcock, Hua, Mazouz, and Yin (2014); Rauch et al. (2009)). Moreover, I add contingency factors representing a sense of urgency, operationalized through pre-crisis profitability, and a counterbalancing factor to mitigate adverse effects of an overly ambitious entrepreneurial orientation (EO) focus, operationalized through financial leverage. Ultimately, the gaps in existing literature as well as proposals for research guide the overall theme of this dissertation: *How do innovation assets, entrepreneurial actions, and communication strategies drive crisis resilience under firm-specific conditions?*

I break down the overarching theme into three concrete research questions, each triggering an independent research study. All three studies are based on a sample of S&P 1500 companies observed before, during, and after the 2008 Great Financial Crisis (2008 GFC). I rely on secondary accounting, patent, and stock price data as well as on annual reports for my empirical analyses and receive statistical results with the help of OLS regressions, survival models, event studies, and cluster analyses.

Study I relates pre-crisis innovation to organizational resilience as defined by DesJardine, Bansal, and Yang (2019) and adds a contingency of pre-crisis profitability. I can strongly confirm that pre-crisis innovation is beneficial in times of systemic distress and found even stronger associations for companies that economically underperformed before the crisis's onset. Study II evaluates a company's entrepreneurial orientation in relation to short-term market reactions. While the operationalization of crisis resilience through an event study is new to this research domain, I follow Covin and Slevin (1989) and Lumpkin and Dess (1996) to conceptualize and determine entrepreneurial orientation. Results indicate that an entrepreneurial

orientation supports organizational resilience, while effects are even stronger if firms are financially leveraged. I argue that financial leverage has the power to offset the harmful effects of an overly ambitious EO strategy. Study III is explorative in nature and touches upon the dimension of innovation communication. By running a cluster analysis, I identify four communication types, i.e., unostentatious, silent, multiloquent, and factual innovators. While none of these communication types is per se superior, silent innovators show the worst crisis recovery performance, while multiloquent and factual innovators appear equally strong.

I base my findings on established management theories, i.e., the resource-advantage theory (Hunt & Morgan, 1995), the network theory (Granovetter, 1973), the contingency theory (Galbraith, 1973), and the human capital theory (Becker, 1964). My findings partly enrich and extend the above theories by showing that firm performance and organizational resilience are, while being conceptually distinct, similar in their impact.

My dissertation makes valuable academic contributions. First, it extends the theoretical knowledge of antecedents and contingencies of organizational resilience. Second, my work introduces an alternative method to evaluate organizational resilience, i.e., by employing an event study approach. Third, my studies sharpen the resource-advantage and contingency theory by replacing firm performance with organizational resilience. Practitioners can refer to this dissertation to fortify their business. First, my dissertation motivates management teams to specifically take preparative – in addition to reactive – crisis mitigation actions. Second, this work advises the company leadership to constantly strive for renewal and optimization of their business model and strategic orientation to keep up with environmental changes triggered by economic shocks. Third, my studies suggest that chief officers should not only focus on pure innovation activities but also consider the communication-to-stakeholder element.

Naturally, this dissertation contains certain limitations that translate into avenues for future research. Three points stand out. First, further research can be inspired by considering more experimental and innovative papers that are not yet covered by renowned academic journals and by pursuing a data-driven approach to literature review. Second, my research can be further developed by integrating additional innovation measures and considering alternative concepts to determine organizational resilience. Third, the methodology can be fortified by verifying my findings in study III through advanced statistical methods.

All in all, my work guides the academic research stream of crisis management in general and organizational resilience in specific and can motivate management teams to fortify their organizations such that upcoming systemic crises constitute an economic break rather than an organizational breakdown.

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List of abbreviations

[n/a]	Not applicable
2SLS	Two-stage least squares
9/11	Terroristic attacks on the World Trade Center on September 9, 2001
a.k.a.	Also known as
ABWL	Allgemeine BWL (JOURQUAL 3 category)
API	Application programming interface
B2B	Business-to-business
B2C	Business-to-consumer
BA-FI	Bankbetriebslehre/Finanzierung (JOURQUAL 3 category)
BM	Business model
BMI	Business model innovation
CAR	Cumulative abnormal return
CEO	Chief executive officer
CIK	Central index key
COVID-19	Corona virus disease 2019
CRSP	Center for Research in Security Prices
CSR	Corporate social responsibility
CSST	Creative, strategic scenario thinking
CxO	Chief [placeholder] officer
DV	Dependent variable
e.g.	For example (Latin: exempli gratia)
EBITDA	Earnings before interest, taxes, depreciation, and amortization
EDGAR	Electronic data gathering, analysis, and retrieval
EO	Entrepreneurial orientation
esp.	Especially
et al.	And others (Latin: et alii)
EVA	Economic value added
GDP	Gross domestic product
GFC	Great Financial Crisis
GVIF	Generalized variance inflation factor
GVKEY	Global Company Key
i.e.	That is (Latin: id est)

IC	Intellectual capital
ICT	Information, communication, technology
ID	Identification
incl.	including
INT	Internationales Management (JOURQUAL 3 category)
IV	independent variable
KMU	Kleine und mittlere Unternehmen (JOURQUAL 3 category)
LT	Long-term
M&A	Mergers and acquisitions
MARK	Marketing (JOURQUAL 3 category)
MD&A	Management discussion and analysis
Med.	Mediator variable
Mgmt.	Management
MNC	Multinational corporation
Mod.	Moderator variable
MVA	Market value added
OLS	Ordinary least squares
OR	Organizational resilience
ORG / PERS	Organisation/Personalwesen (JOURQUAL 3 category)
PACAP	Potential absorptive capacity
PERMCO	Permanent issue identifier (CRSP)
PERMNO	Permanent company identifier (CRSP)
R&D	Research and development
RACAP	Realized absorptive capacity
RAT	Resource-advantage theory
ROA	Return on assets
RQ	Research question
S&P	Standard & Poors
SCM	Supply chain management
SD	Standard deviation
SEC	U.S. Securities and Exchange Commission
SEP	Social and environmental practices
SIC	Standard industrial classification
SM	Strategisches Management (JOURQUAL 3 category)

SME	Small- and medium-sized enterprises
SSEP	Strategic social and environmental practices
ST	Short-term
TIE	Technologie, Innovation und Entrepreneurship (JOURQUAL 3 category)
TSEP	Tactical social and environmental practices
U.S.	United States
USA	United States of America
USP	Unique selling proposition
USPTO	United States Patent and Trademark Office
VHB	Verband der Hochschullehrer für Betriebswirtschaft
VHB-JQ3	VHB-JOURQUAL3
VIF	Variance inflation factor
vs.	Versus
WC	Word count
WoS	Web of Science
WRDS	Wharton Research Data Services

List of symbols

#	Number of
μ	Average
d	Day(s)
F	Empirical value of F-statistic
H	Hypothesis
N / n	Number of observations
p	Statistical probability
R^2	Coefficient of determination

Part A: Introductory overview

Part A contains the frame of my dissertation and starts with an introduction (chapter 1) detailing my research motive and the overall approach (chapters 1.1 and 1.2). A thorough literature review consisting of a description of the identification process (chapter 2.1) and a literature analysis (chapter 2.2) follow. Identifying the research gap and defining the research questions, complete this section (chapter 2.3).

Chapter 3 outlines the relevant theoretical foundations. The research design is explained in chapter 4. It includes a short rationale for choosing the 2008 Great Financial Crisis as the central crisis for this research (chapter 4.1), a description of the sample development (chapter 4.2), and an outline of the methodological approach (chapter 4.3).

Chapter 5 contains the summaries of my research studies I to III. Part A concludes with a summary of my main findings (chapter 6.1), relevant academic and practical contributions (chapters 6.2 and 6.3), and an overview of limitations that lead to avenues for future research (chapter 6.4).

1 Introduction

This introductory section describes this dissertation's research motive and explains why analyzing the topic of organizational resilience is not only exciting but explicitly necessary in the current times of uncertainty (section 1.1). An outline of the structure of this dissertation is presented afterward (section 1.2).

1.1 Research motive and intention

While the economic constraints of the COVID-19 pandemic are about to phase out, economic challenges triggered by the Russian attacks on Ukraine seamlessly took over. Global supply chains are still or even more disrupted (Clark, 2022), energy prices are on the rise to an all-time high (Tan & Lee, 2022), a global food crisis approaches (WFP, 2022), and COVID-19 might strike back in autumn (Keersmaecker & Favalli, 2022). These challenges join the ranks of the Great Financial Crisis (2008), the 9/11 attacks (2001), the dot-com bubble (2000), and the Asian crisis (1997), to name only the most relevant systemic shocks of the past 25 years. Even when switching from an anecdotal, backward-looking perspective to a survey-based outlook, the global risk perception is hardly more optimistic. A mere 11% of participants respond to the question "What is your outlook for the world over the next three years?" with "Accelerating global recovery," while the remaining 89% firmly believe in negative scenarios (World Economic Forum, 2022). Respondents expect consistent volatility with multiple surprises (42%), fractured trajectories separating relative winners and losers (37%), or progressive tipping points with increasing catastrophic outcomes (10%).

Past developments and future challenges let political leaders and governments, CEOs and management teams, as well as private individuals and social communities call for guidance, orientation, and support. As such, decision-makers approach academia and crisis management experts not merely to learn more about the most suitable short-term crisis mitigation strategies

but rather how to best prepare for the next economic shock, thereby addressing the topic of *organizational resilience*.

Denver (2017: 5) defines organizational resilience as "the ability of an organization to anticipate, prepare for, respond and adapt to incremental change and sudden disruptions in order to survive and prosper." His definition includes a time component (i.e., anticipate/prepare, respond, and adapt), stresses firms' ultimate goals (i.e., survive and prosper), and hints toward beneficial characteristics and capabilities (i.e., ability).

Hillmann and Guenther (2021) and Linnenluecke (2017) confirm the increased interest in the topic of organizational resilience, not only by the number of publications at the interface of business and resilience, which rose from less than ten yearly articles until 2006, to more than 60 papers 2013 but also by stressing that while "resilience is generally seen as a desirable characteristic [...] many organizations will find themselves unprepared for the impacts of adverse events unless they build suitable capacities" (Linnenluecke, 2017: 4 & 27). Accordingly, chief officers (CxOs) and management teams are not at the mercy of a systemic crisis but can instead actively take provisions for the future.

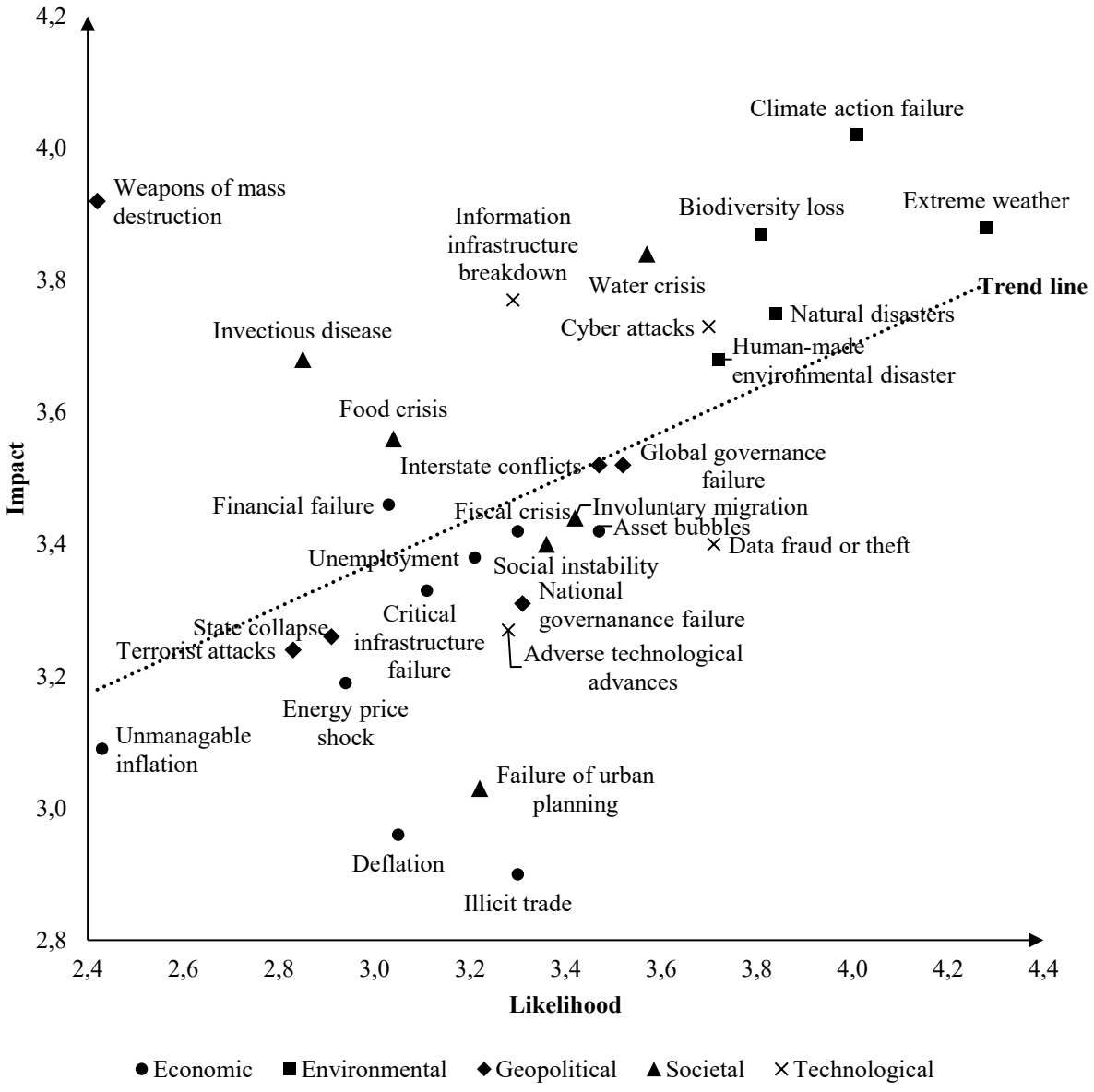
To date, academic literature contributed many factors that drive firm performance, but much less is known about those which strengthen organizational resilience. Regarding the latter, i.e., organizational resilience, Duschl (2016) confirms the positive influence of a competitive environment while Paunov (2012) highlights the access to public funding as beneficial for continuing innovation projects during times of distress. Mzid, Khachlouf, and Soparnot (2019) add the value of social, financial, and human capital, with the first one being specifically important for small, entrepreneurial-driven companies. The value of financial capital and concomitant flexibility is threefold as it allows to fulfill short-term obligations (e.g., Ferrando et al. (2017)), mid-term survival (e.g., Brown and Petersen (2015)), and long-term growth (e.g., Gittell, Cameron, Lim, and Rivas (2006)). While resilience benefits of in-crisis innovation can also be inferred from its relationship to firm performance (e.g., Adcock et al. (2014); Cruz-Castro, Holl,

Rama, and Sanz-Menéndez (2018)) Ahn, Mortara, and Minshall (2018) critically note that in-crisis research & development (R&D) investments consume valuable cash reserves and thus hurt short-term profitability. Knowledge on resilience building factors is completed by research on contingencies such as industry stage (e.g., Lumpkin and Dess (2001)), firm size (e.g., Bartz and Winkler (2016); Rauch et al. (2009); Yoshikuni and Albertin (2018)) or learning orientation (e.g., Soares and Perin (2019)), corporate governance (e.g., Buyl et al. (2019)) and CEO pay (e.g., Sajko et al. (2020)).

However, little research has been pursued on the pre-crisis innovation/entrepreneurship-to-resilience relationship and even less on firm-specific contingency factors. This is problematic for two reasons. First, innovation and entrepreneurship are already known for their positive contribution to firm performance (e.g., Iacobucci and Perugini (2021)). However, to date, literature cannot constitute a dual role of benefits, i.e., one which yields benefits during times of stable business and during times of economic shocks equally well. This duality is expected to gain relevance as recent history shows that significant downturns are not rare exceptions and as the future outlook is neither more positive. In their yearly global risk survey, the World Economic Forum (2021) identified 30 different threats and arranged them on a likelihood-impact matrix. The diversity of threats and the linear, upward-sloping trend line alone constitute the importance and relevance of expected risks (Figure 1).

Second, in an environment of increasing complexity, firms do not only find their individual paths to run their business, but neither are typically positive attributes and characteristics beneficial in all situations. This calls for the consideration of contingencies. Differentiating factors may constitute elements of the profit and loss account (e.g., revenue and costs), positions on the balance sheet (e.g., long-term assets and short-term debts), general firm characteristics (e.g., size, age, and governance structure), the environmental situation (e.g., level of intra-industry competition), and many more. Only a meaningful interpretation limits choice and selection.

Figure 1: Global risks landscape



Note: Axes do not start in P(0/0) and are of different scale
Source: World Economic Forum (2021)

Considering all this and being backed by renowned authors who reiterate the need for additional academic confirmation (Hillmann & Guenther, 2021; Linnenluecke, 2017), this dissertation's overall research theme reads as follows:

Superior research theme: *How do innovation assets, entrepreneurial actions, and communication strategies drive crisis resilience under firm-specific conditions?*

This dissertation's goal is to shed light on resilience-building factors in the area of innovation and entrepreneurship, to expand knowledge on relevant interactions of innovation, and to take a slight look into the adjacent topic of innovation communication during times of distress.

To reflect on this research theme academically, I pursue a systematic, in-depth literature review to outline the current state of knowledge on the one hand and to identify a research gap and derive my exact research questions on the other hand. I build my research on four established management theories and create a data set of S&P 1500 companies to analyze resilience-contributing factors empirically. My methodology consists of four different statistical approaches that relate the different variables to each other and provide interpretable outputs. I establish my core findings and interpretations in three independent studies. I conclude this research with a discussion of my results, their academic and practical implications, and a statement of limitations that simultaneously shape and inspire avenues for future research.

All in all, I hope this work will guide academic audiences, management teams, and private individuals to understand crises as a chance for long-term success even though initial losses may mar short-term mood and success.

1.2 Approach and structure

This dissertation is structured in two overarching parts: Part A represents this dissertation's frame, and part B comprises three independent, full-length research studies that constitute this academic work's core. To start with, I outline this work's structure in sequential order.

Following this introductory chapter (section 1) with a discussion of my research motive and intention (section 1.1), I provide a review of relevant literature on this dissertation's topic (section 2). In detail, I describe the systematic process of literature identification (section 2.1.1)

and present a set of descriptive statistics (section 2.1.2). A content-based analysis of 62 relevant articles elaborates on prior work, shows interdependencies and assigns each article to one of five categories (section 2.2): environment & situation (section 2.2.1), assets & resources (section 2.2.2), actions & decisions (section 2.2.3), skills & capabilities (section 2.2.4), and resilience & performance (section 2.2.5). Section 2 concludes with an identification of the research gap and a formulation of three central research questions (section 2.3).

To academically embed my research into a theoretic frame (section 3), I present the main characteristics, assumptions, and core propositions of the resource-advantage theory (section 3.1), network theory (section 3.2), contingency theory (section 3.3), human capital theory (section 3.4), and the efficient market hypothesis (section 3.5).

Chapter 4 deals with the research design. I first explain why I chose the 2008 Great Financial Crisis as my research focus (section 4.1), describe how I collected and connected my data, and eventually derived my final sample (sections 4.2, 4.2.1, and 4.2.2). A description of the methodological approach with reasoning on statistical model selection concludes this chapter (section 4.3). A summary of each of my three research studies is presented in section 5. I briefly outline each study's research need, hypotheses, methodology, results, and implications (sections 5.1 to 5.3).

Part A closes with a concluding discussion (section 6). More specifically, I summarize my findings concerning the three central research questions (section 6.1), elaborate on the academic and theoretical contributions (section 6.2), present my suggestions to management teams (section 6.3), relate limitations to avenues for future research (section 6.4), and ultimately phase out with final remarks (section 6.5).

Part B contains my three independent research studies, each structured along abstract, introduction, methodology, results, and discussion, and equipped with figures, tables, and a complete list of cited references. The independent papers have been submitted to renowned academic journals for publication.

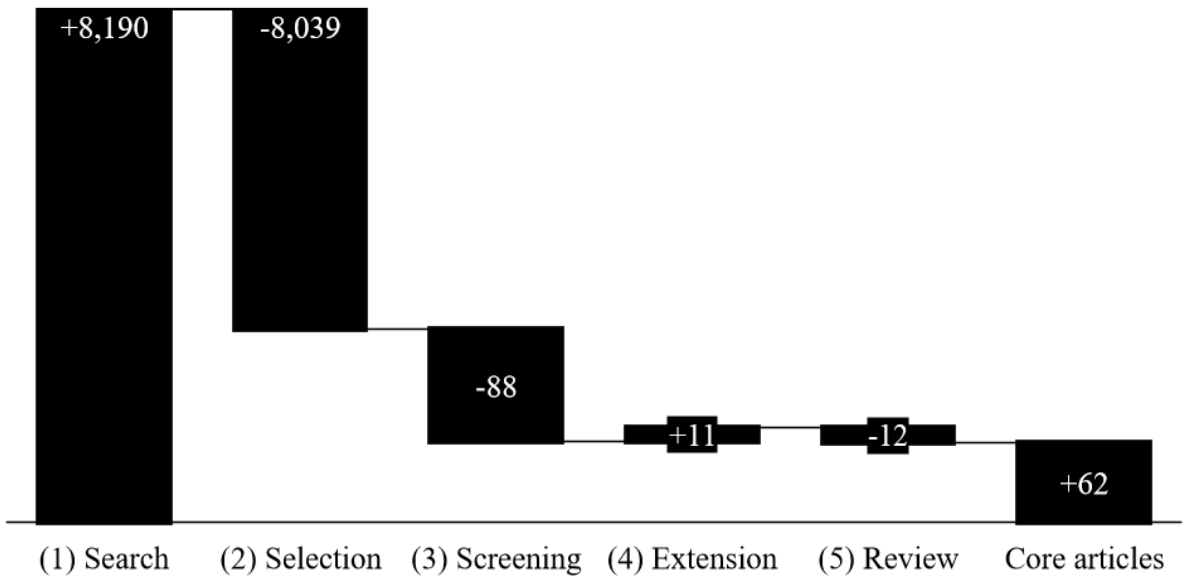
2 Literature review

This chapter reviews the existing research at the interface of systemic crises, organizational resilience, innovation behavior, and entrepreneurial orientation through a methodical, state-of-the-art literature analysis. The assessment aims to identify research gaps that will guide the formulation of this dissertation's research questions. I progress along a three-level structure: Section 2.1 describes the literature identification process; section 2.2 systematically analyzes the core articles; and section 2.3 presents the research gap and derived research questions.

2.1 Identification of relevant literature

This chapter describes the five-step process of identifying relevant academic literature and presents descriptive statistics for the selected studies that cover the categories of environment & situation, assets & resources, actions & decisions, skills & capabilities, and resilience & performance. The process reduces the initial sample of 8,190 items to 62 core articles (Figure 2).

Figure 2: Waterfall chart for identification of relevant literature



Note: height of columns 1 and 2 are not drawn to scale
Source: own illustration

2.1.1 Process of systematic literature review

I follow the five-step process as shown in Figure 3 to destine 62 core articles. This method represents a structured, reproducible, and thorough literature assessment and thus forms a solid basis for my dissertation (Brocke, Simons, Niehaves, & Cleven, 2009; Randolph, 2009).

First, I perform a broad academic paper search based on relevant trigger words. The basis for the initial examination is the Web of Science (WoS) Core Collection database, a global, trusted, and publisher-independent citation catalog (Clarivate, 2022). The search is conducted on documents' titles, abstracts, author keywords, and KeyWords Plus. KeyWords Plus is a WoS proprietary algorithm that generates additional keywords based on documents' titles and abstracts, thus expanding the results to related topics and disciplines. I turn the option *Exact search* off so that WoS uses a combination of stemming and lemmatization to incorporate plurals (e.g., mouse and mice) and alternative writings (e.g., color and colour) of the search terms. I develop a search query that combines the domains of crises, resilience, innovation, and entrepreneurship. To incorporate the most recent literature, especially in light of a current COVID-19-related research increase, I include all papers published until April 21st, 2022. My query consists of three higher-level elements linked with the Boolean AND operator.

Element one specifies the topic of crisis. Merriam-Webster (2022) defines the term crisis as "an unstable or crucial time or state of affairs in which a decisive change is impending; especially: one with the distinct possibility of a highly undesirable outcome." As such, the term covers, among others, the range of undesirable natural, psychological, medical, or economic events, thereby setting the overall theme of my dissertation. Explicit synonyms include shock, distress, and disaster; implicit synonyms are catered for by the WoS algorithm (KeyWords Plus and Exact search turned off).

Element two specifies the topic of resilience. While the concept of resilience has its roots in ecology, other disciplines adopted and modified the idea to fit their domain (American Psychological Association, 2012; Vegas & Del Martin Yerro, 2013). Management research

understands resilience typically as *organizational resilience*, i.e., firms' ability to respond faster to adverse situations or recover quicker from unexpected downturns (Vogus & Sutcliffe, 2007). Explicit synonyms include flexibility, stability, recovery, and rehabilitation; implicit synonyms are catered for by the WoS algorithm (KeyWords Plus and Exact search turned off).

Element three specifies the topics of innovation and entrepreneurship. While richly defined and used in the context of management research, innovation and entrepreneurship are the only elements that limit the initial search to the area of business in its broadest sense. Innovation and entrepreneurship, although conceptually unique, are mutually dependent (Bessant & Tidd, 2007; Drucker & Maciariello, 2015; Hagedoorn, 1996) and therefore used in combination. Drucker and Maciariello (2015) connect the two terms by pointing out that entrepreneurs always strive for change and exploit new situations as opportunities. From this, they derive that the process of exploiting change happens through innovation. Explicit synonyms include novelty, improvement, upgrade, update, R&D, and research development; implicit synonyms are catered for by the WoS algorithm (KeyWords Plus and Exact search turned off). The entire query for my initial search reads as:

> TS=(crisis OR shock OR distress OR disaster) AND TS=(resilience OR flexibility OR stability OR recovery OR rehabilitation) AND TS=(innovation OR novelty OR improvement OR upgrade OR update OR entrepreneurial orientation OR R&D OR research development)[1]

Due to WoS KeyWords Plus and Exact search functionalities, there is no need to include additional synonyms, work with wild cards, or pay attention to case sensitivity. Thus, step (1) Search leads to 8,190 results.

[1] TS = Topic; OR = Boolean operator "or"; AND = Boolean operator "and"

Figure 3: Process overview for systematic identification of literature review

	(1) Search	(2) Selection	(3) Screening	(4) Extension	(5) Review
Activity	Identification of total literature sample via Web of Science query	Initial filtering to ensure general topic fit and scientific quality	Abstract screening to filter by content focus and methodology	Addition of academic literature by forward and backward search	Full paper review to categorize literature and identify the research gap
Details	*Database:* Web of Science Core Collection *Query:* Search for crisis, resilience, innovation, and entrepreneurship (incl. synonyms) *Scope:* Title, abstract, author keywords, KeyWords Plus *Period:* until April 21st, 2022	*Type:* Research articles (-1,490) *Language*: English (-327) *VHB-JQ3 selection:* Rating: A+, A, B, C (-6,044) Categories: ABWL, BA-FI, Entrepreneurship, INT, KMU, MARK, ORG / PERS, SM, TIE (-178)	*Exclusion filter*: Missing focus on Systemic crisis (-34) Corporate mgmt. (-15) Org. resilience (-15) Corporates (-12) Incompatible due to Methodology (-12)	*Content inclusion filter:* Specific focus on Org. resilience (+6) Entrepr. orientation (+4) Innovation (+1)	*Content exclusion filter:* Comment or research agenda without relevant academic contribution (-9) Core topic only in minor focus Entrepr. orientation (-1) Innovation (-1) Strategy (-1)
Results	8,190	151	63	74	62

Source: own illustration

Second, I filter the initial sample of 8,190 results to ensure general topic fit and scientific quality. The initial search includes a variety of documents types (e.g., articles, books, comments, reviews), languages (e.g., English, Spanish, Russian, German), academic qualities (e.g., A+ to D, not rated), and categories (e.g., business, computer sciences, controlling, health care, logistics). As such, I apply the following selection criteria to receive a reasonable collection of papers:

- type must be traditional research articles (-1,490),
- language must be English (-327),
- VHB-JOURQUAL3 (VHB-JQ3) rating must be A+, A, B, or C (-6,044), and
- VHB-JQ3 categories must be any of ABWL, BA-FI, Entrepreneurship, INT, KMU, MARK, ORG / PERS, SM, TIE (-178)[2].

I am well aware that including articles from journals with a VHB-JQ3 (Verband der Hochschullehrer für Betriebswirtschaft-JOURQUAL 3) rating of C is discussable. However, given that the academic interest in and coverage of organizational resilience research is still developing (Linnenluecke, 2017), an inclusion of lower-rated publications does primarily enrich, rather than harm, my literature review. By including articles from C-rated journals, I extend the shortlist for step (3) screening from 292 to 415 articles (i.e., by 123 articles or 42% respectively). The significant loss of 6,044 results by excluding VHB-JQ3 D-rated and non-rated journals is acceptable as this step particularly excludes non-peer-reviewed articles, thus benefiting overall quality. Therefore, all selection criteria together reduce the number of results to 151.

Third, I screen all 151 abstracts and filter them by content focus and methodology. Overall, I drop academic papers if they do not show a clear focus on any of my dissertation's core

[2] ABWL = General business administration, BA-FI = Banking management / financing, INT = International management, KMU = Small and medium enterprises, MARK = Marketing, ORG / PERS = Organization and personell, SM = Strategic management, TIE = Technology, innovation and entrepreneurship

topics. As such, I exclude papers due to a missing focus on systemic crises (-34, e.g., Rasoulian, Grégoire, Legoux, & Sénécal, 2017; Wang, Müller, Zhu, & Yang, 2021; Weber, 2011), corporate management (-15, e.g., Antonelli, Leone, & Ricci, 2022; Justiniano & Primiceri, 2008; Marsili, 2014), organizational resilience (-15, e.g., Hittle & Moustafa Leonard, 2011; Ozanne & Ozanne, 2016; Phillips, Roehrich, Kapletia, & Alexander, 2022), and corporates (-12, e.g., Anagnostopoulos, 2018; Nakhli & Gaies, 2021; Vahanvati & Mulligan, 2017). I further ignore papers if their methodology is incompatible with my dissertation's research design (-12, e.g., Bathelt, 2001; Bussiere & Fratzscher, 2006; Caverzasi & Russo, 2018). Thus, step (3) Screening leads to 63 results.

Fourth, I carefully extend the selection of papers by a forward and backward search. As some authors use unconventional or highly specific phrasings in titles, abstracts, or keywords, I find additional 11 papers with potentially relevant contributions. These papers deal with organizational resilience (+6, e.g., DesJardine et al., 2019; Linnenluecke, 2017), entrepreneurial orientation (+4, e.g., Lumpkin & Dess, 1996; Soares & Perin, 2019), and innovation (+1, e.g., Srinivasan et al., 2011). Except for the paper of Soares and Perin (2019), which has not been rated by VHB-JQ3, all manually added papers fulfill the quality checks pursued in the previous step. Thus, step (4) Extension leads to an overall sample of 74 results.

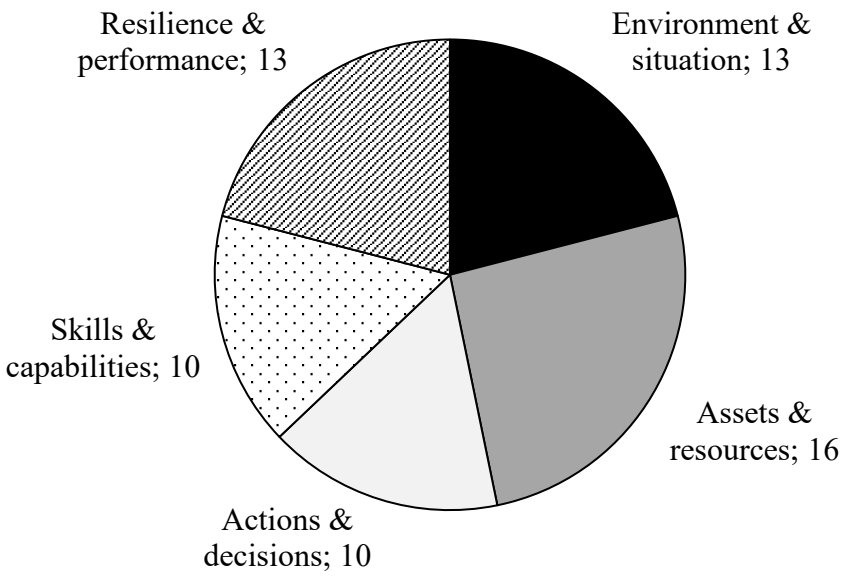
Fifth, I perform a full paper review of 74 articles to categorize the literature and identify this dissertation's research gap. In this last step, I exclude another 12 papers for various reasons. Some papers contain subjective comments without any relevant academic contribution (-9, e.g., Chowdhry, 2010; Lundvall, 2017). Others only lightly touch upon the topics of entrepreneurial orientation (-1, i.e., Liang & Goetz, 2016), innovation (-1, i.e., Martinez, Renukappa, & Suresh, 2021), and strategy (-1, i.e., Marom & Lussier, 2021). This last step leads to 62 core articles that I further analyze in my literature review.

2.1.2 Descriptive characteristics of selected literature

To get a good overview of the final collection of 62 core articles, I prepared a set of descriptive statistics which provide distributions relating to topic, timing, quality, journal representation, geography, and methodology.

I assign each of the 62 articles to one dominant category based on keywords, abstract, main finding, statistical measures, and full paper review to understand where existing literature has focused on (Figure 4). The naming and order of the five categories is an anticipation of the literature analysis structure in chapter 2.2 (Figure 13). The number of publications is relatively uniformly distributed, with publications relating to assets & resources being slightly larger than others (16 out of 62, 26%). 13 articles belong to the theme of environment & situation and resilience & performance (21%), and 10 articles are categorized as actions & decisions and skills & capabilities (16% each).

Figure 4: Distribution of articles by dominant category

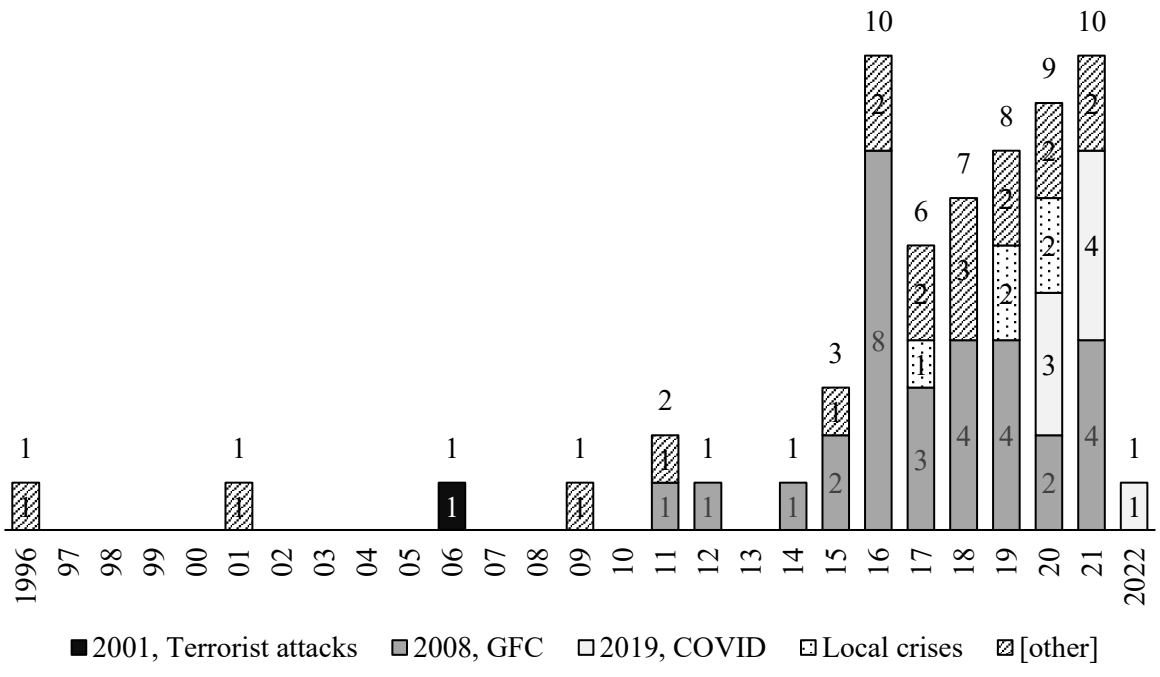


Source: own illustration

Given that economic crises happen repeatedly, I investigate the temporal development of the core articles (Figure 5). 90% of relevant contributions were published in the last ten years,

even though the earliest publication dates back to 1996. Interestingly, earlier economic crises, e.g., the 1973 oil price shock or the early 1980s recession, did not motivate researchers to investigate the domain of resilience. The timeline further shows that the academic interest in crises differs between crisis triggers. While the 2001 terrorist attacks generated only one publication, the 2008 Great Financial Crisis (GFC) sparked significant interest from 2011 onwards (30 articles to date); also, COVID-19 has already triggered valuable academic publications (8 articles to date). Lastly, I can constitute an increase in reaction speed. It took academic research three years to address the 2008 GFC (i.e., the first publication in 2011), but not even one year to publish articles on the COVID-19 pandemic (i.e., the first publications in 2020).

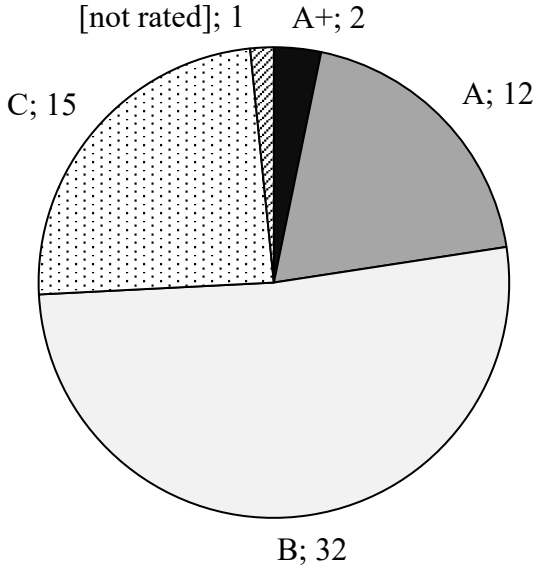
Figure 5: Temporal development of literature by crisis trigger



Note: the year 2022 is only covered until April 21st
Source: own illustration

Since publication quality is central to a literature assessment and research gap definition, I review the distribution of represented journals by the VHB-JQ3 rating. Because resilience research only gained traction in recent years, I purposely decided to include papers publicized in lower, C-rated journals. In my final collection of 62 core articles, articles in B-rated journals represent the absolute majority (32 articles, 52%), while the remainder splits relatively evenly between A+ & A (14, 23%) and C & not rated (16, 26%). The only publication not covered by VHB-JQ3, i.e., Soares and Perin (2019), has been manually added as part of the literature identification process (Chapter 2.1.1). Overall, I can state that articles on resilience are only partly covered by the highest-quality journals. Potential reasons may include the journals' lack of interest or the articles' insufficient quality standards.

Figure 6: Distribution of articles by their journal's VHB-JOURQUAL3 rating



Note: the article published in a non-rated journal has been manually added as part of step (4) Extension in the literature identification process (Chapter 2.1.1); one journal received a rating of B/C and is represented here as part of the C cluster
Source: own illustration

My 62 core articles are published in 39 different journals. Six journals published three or more, and seven published exactly two articles. The remaining 26 journals published only

one single article on the combined topic of crisis, resilience, and innovation/entrepreneurship (Table 1). An evaluation of the journals' foci reveals that the topic of resilience does not have a natural home but is covered by an extensive range of disciplines. Examples include business or management (e.g., Journal of Business Research and Journal of Management), innovation, marketing or strategy (e.g., R&D Management, Economics of Innovation and New Technology, Industrial Marketing Management), and finance or SMEs (e.g., Journal of International Money and Finance, Journal of Small Business Management). The observation that no journal carries the terms crisis or resilience in its title supports the supposition of fragmented coverage.

Table 1: Academic journals included in the literature review

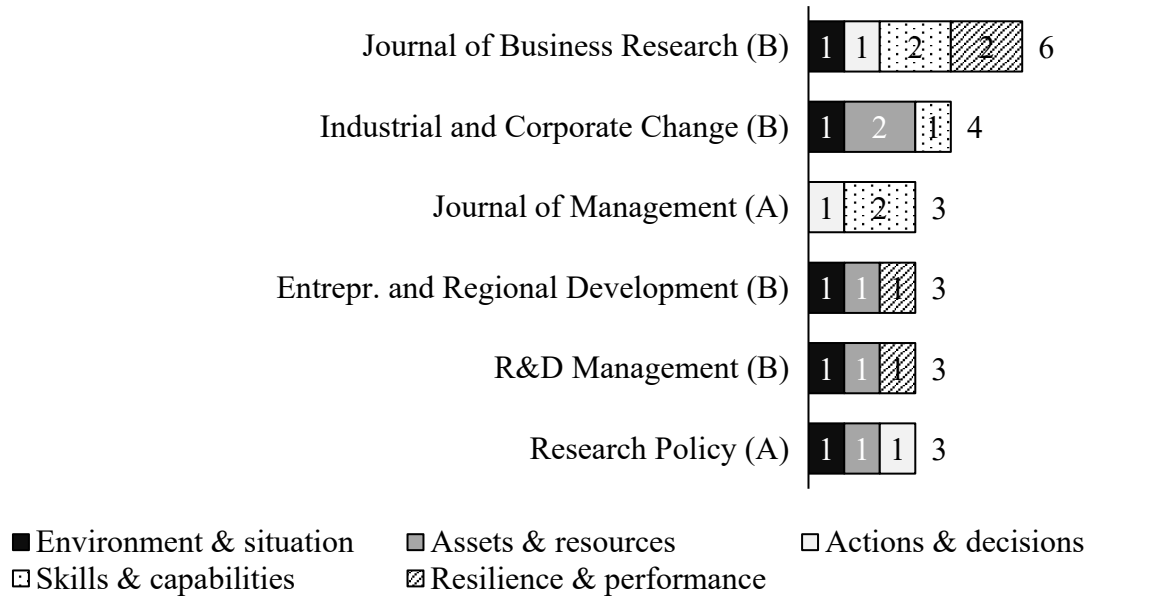
Journal title	VHB JQ3 rating	# of publications
Journal of Business Research	B	6
Industrial and Corporate Change	B	4
Journal of Management	A	3
Research Policy	A	3
Entrepreneurship and Regional Development	B	3
R&D Management	B	3
Journal of Business Venturing	A	2
Economics of Innovation and New Technology	B	2
International Journal of Management Reviews	B	2
Industrial Marketing Management	B	2
Industry and Innovation	B	2
Management Decision	C	2
Int. Journal of Productivity and Performance Mgmt.	C	2
Journal of Marketing	A+	1
Academy of Management Review	A+	1
Strategic Entrepreneurship Journal	A	1
Strategic Management Journal	A	1
Entrepreneurship Theory and Practice	A	1
Journal of Financial Intermediation	A	1
Journal of International Money and Finance	B	1
International Journal of Innovation Management	B	1
Human Resource Management Journal	B	1
Journal of International Management	B	1
Journal of Small Business Management	B	1
European Financial Management	B	1
Small Business Economics	B	1
Journal of Applied Behavioral Science	B	1
Int. Entrepreneurship and Management Journal	B/C	1
Asia Pacific Business Review	C	1
Business Horizons	C	1
Baltic Journal of Management	C	1
Corporate Governance-An International Review	C	1
European Journal of Marketing	C	1
Multinational Business Review	C	1
Journal of Intellectual Capital	C	1
Journal of International Entrepreneurship	C	1
Technology Analysis & Strategic Management	C	1
Journal of Business & Industrial Marketing	C	1
Rausp Management Journal	[n/a]	1

Source: own illustration

Looking closer into those journals that published more than three articles, I see a uniform distribution across research categories. None of the six journals has a clear focus on any component of organizational resilience. Interestingly, the same holds when counting research categories: The categories of environment & situation, assets & resources, and skills & capabilities are covered five times, resilience & performance four times, and actions & decisions three times.

The missing dominance and high fragmentation indicate that interest in organizational resilience is broad for both journals and researchers, but resilience literature has not yet found its natural home.

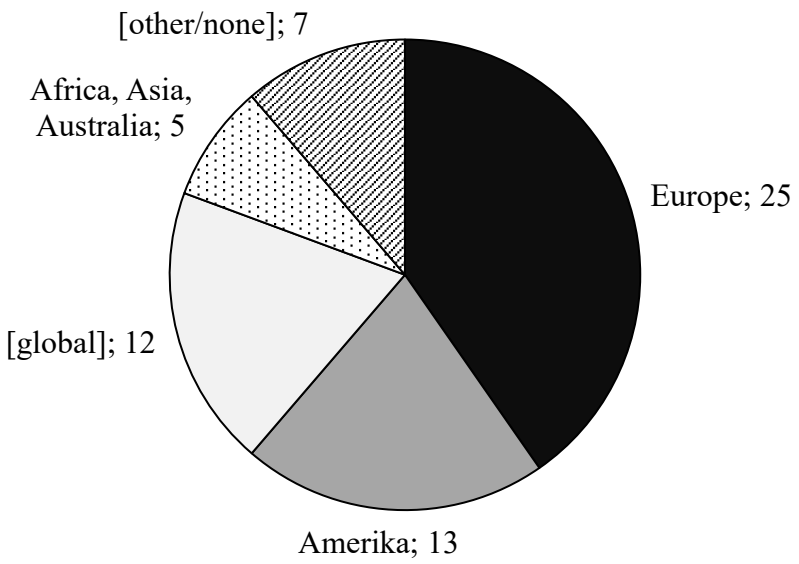
Figure 7: Focus of journals with 3 or more publications by dominant research category



Note: 33 journals with less than three publications are not shown
Source: own illustration

Figure 8 displays the geographic distribution of articles' data samples. Most publications rely on data from Europe (25 articles, 40%) or Amerika (13, 21%). Studies with another geographical focus, e.g., Africa, Asia, and Australia (5 articles, 8%), are underrepresented. 12 studies draw their findings from a global set of data (19%).

Figure 8: Distribution of articles by samples' geographic focus



Note: [other/none] include studies that are non-empirical, e.g., conceptual
Source: own illustration

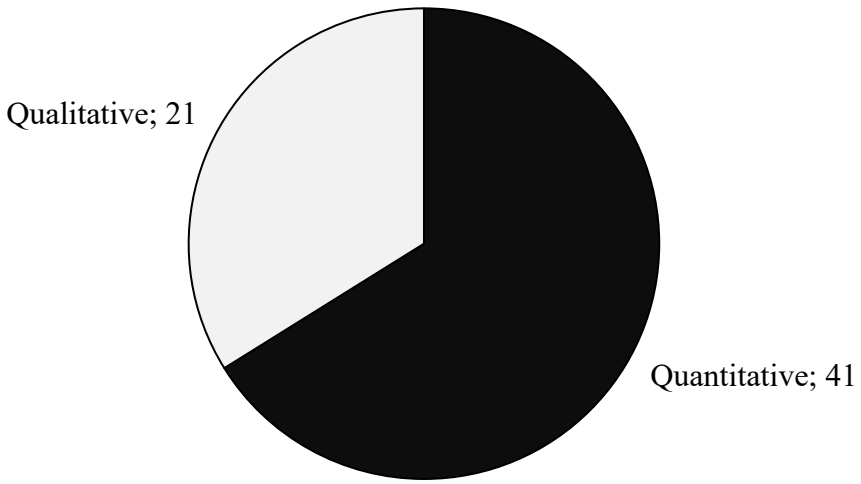
The distribution of sample sizes roughly follows a bell curve, with extremely small, i.e., 1 to 10, and large, i.e., >10,001 samples being the exception. Most studies aggregate and analyze data from 101 to 1,000 entities (18 articles, 29%).

Figure 9: Distribution of articles by sample size

Source: own illustration

Figure 10 breaks down the sample of 62 papers by research type. Two out of three papers (41 articles, 66%) have a quantitative base; the remainder is qualitative (21, 34%).

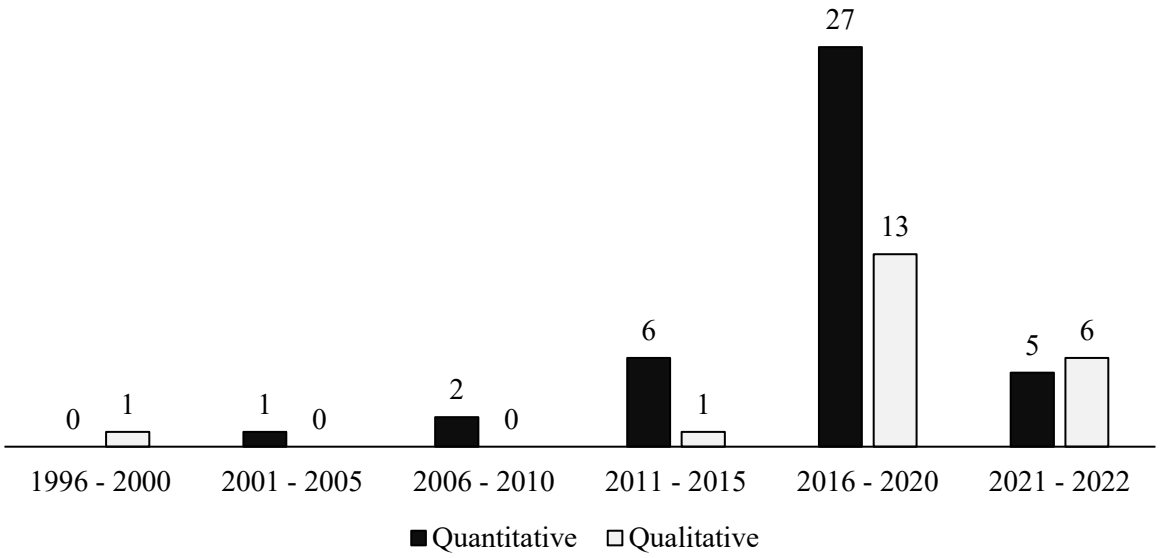
Figure 10: Distribution of research type



Source: own illustration

Arranging the split between qualitative/quantitative research on a timeline (Figure 11), I see that quantitative studies dominated in the past (1996 to 2020, 36 vs. 15 articles) but notice the slight but recent trend that qualitative research catches up (2021 – 2022, 5 vs. 6 articles to date). This development appears unconventional and needs to be further observed because, traditionally, qualitative research precedes qualitative work. Likewise, McLeod (2019) considers qualitative research a starting point or base to which quantitative research adds larger-scale statistical proof.

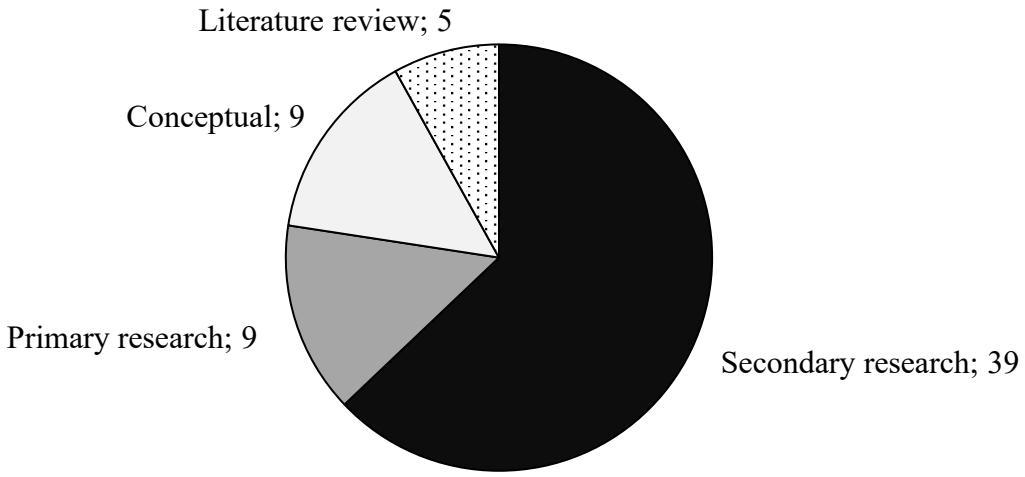
Figure 11: Development of quantitative and qualitative research over time



Note: the year 2022 is covered until April 21st
Source: own illustration

Figure 12 reveals that secondary research dominates my collection of core papers (39 articles, 63%), while primary research and conceptual papers are equally represented (9 each; 14%). Literature reviews (5 articles, 8%), with the most recent publications of, e.g., Duchek (2018) and Linnenluecke (2017), complete the picture.

Figure 12: Distribution of data sources and research character



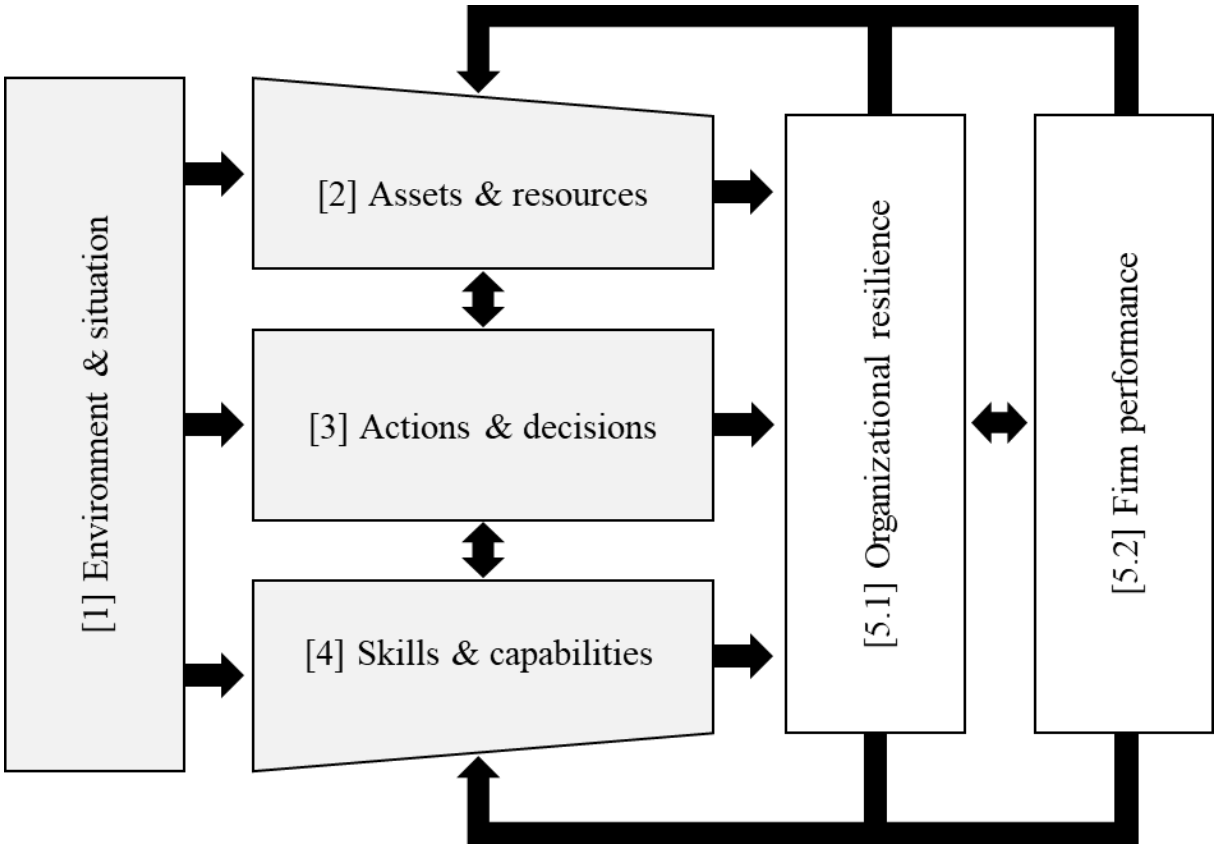
Source: own illustration

So far, I can summarize this subchapter by stating that the combination of crisis, resilience, and innovation/entrepreneurship is represented in relevant academic literature, predominantly because of past years' increased interest. However, the research stream could profit from additional, high-qualitative work and from finding a natural home for resilience literature coverage.

2.2 Literature analysis

To systematically examine the relevant literature of 62 core articles, I arrange this chapter according to the structure as shown in Figure 13. The categorization is based on the article's principal research theme, with elements [1] to [4] representing factors that influence organizational resilience and performance. As described earlier, the numbers of publications per element [1] to [5.1 + 5.2] are uniformly distributed (Figure 4). The arrows between the elements indicate dependencies that reinforce or weaken relationships directly or over time.

Figure 13: Categorization of core articles into the literature framework



Source: own illustration

2.2.1 Environment & situation

The category of environment & situation contains 13 publications and deals with the topics of macroeconomy, industry clusters, financial subsidies, product export, and ownership structure. These aspects have in common that individual organizations can only, if at all, pursue adjustments in the long run. As such, they largely have to be taken for granted when a crisis sets in.

The macroeconomic condition of a region affects companies' precondition to showing organizational resilience. Duschl (2016) found that firms in regions with a competitive environment are assumed to be more resilient in the long run from an evolutionary perspective. They argue that competition "facilitates substitution of outmoded activities with new innovations and technologies" (Duschl, 2016: 880). Such regions, typically characterized by high

growth, skilled workforce, and industry diversity, are superior in structural adaptation and technological re-orientation; this eventually benefits companies in their endeavors to master times of distress. To date, the causality, however, remains unknown.

Research has already confirmed that entrepreneurial behavior in regional clusters supports firm performance (Rauch et al., 2009). According to Iacobucci and Perugini (2021), this also holds for entrepreneurial behavior's relationship to resilience. Causative for the link are overall favorable regulatory conditions, expressed and measured by the birth rate of high-quality start-ups. Second-order contributions to higher resilience levels are start-up-driven job creation and a stronger innovation focus.

Paunov (2012) observes the cancellation rate of innovation projects and relates it to measures of firm characteristics, i.e., availability of internal/external funds and export orientation. The author found that firms with good access to public funding were less inclined to abandon innovation projects during challenging periods. In contrast, younger firms which supply foreign multinational corporations (MNCs) or suffer from export shocks are more likely to cancel innovation projects in critical times. While these results are primarily of interest to policymakers, findings can motivate a firm's management team to proactively build financial buffers that can be consumed during economic downturns (Paunov, 2012).

Marketing firms derive their innovation achievements from product, promotion, placement, and pricing decisions. According to Medrano and Olarte-Pascual (2016), turnover and geographic scope determine the level of success. The authors found that marketing innovations of Spanish enterprises generally decreased in 2010 compared to 2008, primarily to master the 2008 GFC recovery. However, if marketing companies had a strong, outside-EU export focus, innovations remained relevant "to better meet the needs of consumers in the new countries" (Medrano & Olarte-Pascual, 2016: 416). As such, periods of economic distress urge organizations to realize new opportunities and to take additional risks, despite macroeconomic constraints.

Compared to larger enterprises that typically respond to crises with managerial solutions, such as efficiency programs, strategic shifts, market expansions, or mergers and acquisitions, smaller companies tend to react with entrepreneurial answers, such as business model adjustments (Cucculelli & Peruzzi, 2020). Research indicates that a business model change increases a firm's success mainly because they trigger "opportunity-[...] and advantage-seeking behaviors" (Cucculelli & Peruzzi, 2020: 463). However, limited assets, organizational inertia, and lack of management support may reduce the economic benefits of business model adjustments. Mayr, Mitter, and Aichmayr (2017) connect to the idea of business model change by pointing out that adjusting the unique selling proposition (USP) has similar effects on crisis resilience. However, a USP change should be accompanied by corresponding innovation activities and an adequate change process. To avoid duplication and achieve differentiation from competitors, actual "uniqueness is [...] crucial for a sustainable turnaround" (Mayr et al., 2017: 121). According to the authors' statistical analysis, 56% of SMEs succeeded in USP (re)development.

While the value of social capital in family firms has been researched empirically (e.g., Minichilli et al. (2016); Salvato et al. (2020)), a qualitative study by Mzid et al. (2019) underscores the relationships and interdependencies between social, financial, and human capital. In essence, the authors argue that social and human capital support each other and mutually drive financial capital, which in turn – and in its role as a mediator – strengthens crisis resilience. Social capital's relevance and power also hold across different industries and geographies. Specifically, Ferguson, Dahles, and Prabawa (2017) looked at the Indonesian tourism sector and reiterate the importance of interpersonal, cultural, and civil connections in challenging times. The authors expand this view by a boundary-setting and boundary-spanning mechanism. The first, boundary-setting, explains negotiation processes within a shared frame of reference but is guided by individuals' distinct interests. The second, boundary-spanning, resolves differences across fields by generating shared practices (Ferguson et al., 2017).

Recent research has focused on SMEs as research objects. Alonso-Dos-Santos and Llanos-Contreras (2019) found that proactiveness increases the adaptive capabilities of family-run firms such that they make better use of their resources in the post-crisis period. Similarly, a high score on competitive aggressiveness contributes to SMEs' supreme effort to keep the business running despite all challenges. Lastly, a high innovation orientation leads to positive financial results in times of low economic returns, mainly because SMEs tend to make riskier R&D investments when business continuity is threatened (Alonso-Dos-Santos & Llanos-Contreras, 2019). Irrespective of the business cycle, small entrepreneurial firms show a relative growth advantage compared to their larger peers, attributed to SMEs' flexibility advantage. For younger firms, this relationship does not hold. Economic distress disproportionally negatively affects them (Bartz & Winkler, 2016). As such, Bartz and Winkler (2016) identified firm size and firm age as moderators in the entrepreneurship-to-performance relationship.

To conclude this chapter, three points stand out. First, the larger economy around a given organization contributes significantly to overall resilience. Second, smaller companies respond to crises with entrepreneurial solutions, e.g., business model adaptation or USP change. Third, social capital is crucial for smaller companies to master economic challenges, among others, because social capital drives financial and human capital.

Table 2: Literature overview on the category of environment & situation

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Alonso-Dos-Santos, M; Llanos-Contreras, O (2019)	Interplay between socioemotional wealth importance (SEWi) and EO on SME post-crisis recovery	*Research object: Family businesses *Timespan: 2010 *Geographic focus: Chile *N=307 firms *Data sources: questionnaire	Firm performance	Entrepreneurial orientation, socioemotional wealth importance	[not applicable, n/a]	Primary: empirical	*EO drives SME firm performance in post-disaster times *When firm continuity is threatened, SMEs make riskier R&D investments
Bartz, W; Winkler, A (2016)	Performance of small and medium-sized firms during times of stability and distress	*Research object: SMEs *Timespan: 2003 to 2012 *Geographic focus: Germany *N=29,374 firms, 72,594 observations *Data sources: KfW Mittelstandspanel	Firm performance (sales growth, FTE growth)	Entrepreneurship	Firm size, firm age	Secondary: empirical	*Small firms grow stronger than larger ones both in stable and crisis times *Younger firms with stronger growth in stable times, disproportionally negatively affected by economic distress *Thus: crises tend to be overly detrimental to entrepreneurship
Clauss, T; Breier, M; Kraus, S; Durst, S; Mahto, RV (2022)	Temporary business model innovations of SMEs in pandemic times	*Research object: SMEs *Timespan: 2020 and 2021 *Geographic focus: Austria, Germany, Liechtenstein *N=5 firms *Data sources: Semi-structured interviews, archive data, public data	[n/a]	[n/a]	[n/a]	Primary: qualitative	*Temporary business model innovation (BMI) is particularly beneficial for SMEs *Temporary BMI with high fit to original business model (BM) has potential for LT integration *To protect reputation, temporary BM should not harm traditional BM
Cucculelli, M; Peruzzi, V (2020)	Relationship between post-crisis firm survival, learning, and entrepreneurial behavior	*Research object: Manufacturing companies *Timespan: 2002 to 2012 *Geographic focus: Italy *N=67,241 firms *Data sources: AIDA	Firm survival	Crisis response (business model change), family ownership, locality, performance	[n/a]	Secondary: empirical	*BM changes increased post-crisis survival *Adoption of default-reducing BM changes does not happen more frequently in firms that performed poorly in prior crises, thus diminishing the role of entrepreneurial learning

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Duschl, M (2016)	Regional resilience as a consequence of structural adaptation or technological reorientation	*Research object: Spatially equally distributed companies *Timespan: 2007 to 2010 *Geographic focus: Germany *N=20,962 firms, 37,403 growth events *Data source: Amadeus, German Institute of Employment Research	Organizational resilience, firm vulnerability	Economy structure (population density, unemployment rate, growth)	[n/a]	Secondary: empirical	*Firm turbulence, i.e., structural adaption and technological re-orientation, is stronger in regions with high growth, qualified workers, and variety in industries *Causality remains unknown
Ferguson, JE; Dahles, H; Prabawa, TS (2017)	Resilience in the tourism sector	*Research object: Indonesian tourism sector *Timespan: 1995 and 2005 *Data source: Field studies	[n/a]	[n/a]	[n/a]	Secondary: case study	*Social, economic and cultural capital contribute to small-scale business resilience, with social capital being most effective
Iacobucci, D; Perugini, F (2021)	Entrepreneurial ecosystems enhance local resilience to economic crises	*Research object: Italian NUTS-3 provinces *Timespan: 2007 to 2016 *Geographic focus: Italy *N=110 provinces *Data sources: ISTAT	Economy resilience (provincial real value-added, employment level)	Entrepreneurship (entrepreneurial ecosystem index)	[n/a]	Secondary: empirical	*Solid and vital entrepreneurial ecosystem has positive impact on capacity of local systems to resist shocks and recover from crises *Start-up birth rates are correlated to an increase in resilience, in particular, employer enterprises
Mayr, S; Mitter, C; Aichmayr, A (2017)	Identification of ways for SMEs to overcome a crisis and find back to sustainable and lasting renewal	*Research object: SMEs *Timespan: 2004 to 2006 *Geographic focus: Austria *N=393 firms *Data sources: Bankruptcy registers	Sustainable reorganization	Crisis response (repositioning strategy, marketing strategy)	[n/a]	Secondary: empirical	*Pivoting factor of crisis turnaround is repositioning, i.e., finding USP combined with innovation and change
Medrano, N; Olarte-Pascual, C (2016)	Comparison between the implementation of marketing innovations prior to and after a crisis	*Research object: Manufacturing and service companies *Timespan: 2008 to 2010 *Geographic focus: Spain *N=9,415 firms *Data sources: Technological innovation panel	Innovation power (marketing, design, promotion, placement, pricing)	Firm performance (turnover), geographic scope	[n/a]	Secondary: empirical	*Organizational and marketing innovations are positively correlated *Export orientation helps to maintain innovation activities also in times of crisis recovery

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Minichilli, A; Brogi, M; Calabro, A (2016)	Financial performance of family-controlled firms in "steady-state" vs. crises situations	*Research object: Family businesses *Timespan: 2002 to 2012 *Geographic focus: Italy *N=219 firms, 1,235 firm-year observations	Firm performance (ROA, ROE)	Family ownership, family CEO	[n/a]	Secondary: empirical	*Family-controlled firms are more able to absorb exogenous shocks than firms with a diverse shareholder structure
Mzid, I; Khachlouf, N; Soparnot, R (2019)	Performance of family business in a turbulent environment	*Research object: Family businesses *Timespan: 2011 to 2014 *Geographic focus: Tunesia *N=4 firms *Data sources: Semi-structured interviews	[n/a]	[n/a]	[n/a]	Primary: qualitative	*Social capital (esp. local and international contacts) contributes to shock absorption and resource reallocation *Human and social capital support each other, and both drive creation of financial capital, which in turn supports OR
Paunov, C (2012)	(Dis-)Continuation of innovation activities in times of economic distress	*Research object: Manufacturing companies *Timespan: 2008 to 2009 *Geographic focus: 8 Latin American countries *N=1,223 firms *Data sources: Survey	Cancellation of innovation projects	Firm performance (external funds, internal funds, export orientation)	[n/a]	Secondary: empirical	*Public funding prevents firms from abandoning innovation projects *Younger firms and businesses supplying to foreign MNCs or suffering export shocks are more likely to abandon innovation projects
Salvato, C; Sargiacomo, M; Amore, MD; Minichilli, A (2020)	Influence of family ownership and industry positioning on firms' ability to capture opportunities for business recovery	*Research object: Family and non-family businesses *Timespan: 2004 to 2012 *Geographic focus: Italy *N=89 firms *Data sources: Italian chamber of commerce	Firm performance (ROA)	Family ownership, disaster experience	[n/a]	Secondary: empirical	*Family firms performed better than non-family firms, especially when multiple family members were involved as owners *Family ownership is beneficial in industries highly dependent on the public sector

2.2.2 Assets & resources

The category of assets & resources contains 16 publications and deals with the topics of macroeconomy, financial capital, liquidity, intellectual resources, collaboration projects, learning, experiences, and market orientation. These aspects have in common that individual organizations can build and shape these features over time and access, activate or use them once a crisis sets in. Adjustments to these assets & resources can typically happen in the mid-term.

Starting with a macroeconomic view, Adcock et al. (2014) found that a strong, economy-wide innovation focus supports the leading local stock market index. It shows positive abnormal returns in reaction to negative news. The authors acknowledge that R&D investments hurt profitability in the short-term but are necessary for competitive success and revival in times of distress (Adcock et al., 2014; Ahn et al., 2018).

Organizations' adjustments to R&D expenditures in crisis periods are regionally heterogeneous and strongly influenced by the size and type of the local innovation system (Cruz-Castro et al., 2018). However, governmental innovation support only reduces R&D abandonment rates in regions with strong knowledge exploitation. From an organizational perspective, larger, more productive, and export-oriented companies show a stronger dedication to maintaining historical R&D expenditures, despite economic turbulence. The authors further stress that "resilient firms [...] tend to be continuous innovators and engage in cooperation for innovation with other companies and private research centers" (Cruz-Castro et al., 2018: 745). The authors introduce knowledge spillover and within-cluster business variety as moderators.

Relevant literature on the resilience-performance relationship focuses on financial flexibility. Sufficient cash helps companies fulfill financial obligations in the short-term, survive in the mid-term, and make growth investments for success in the long-term (Ferrando et al., 2017). Even though all companies benefit from sufficient liquidity, the value of free cash reserves is higher for private, smaller, and younger firms. Ferrando et al. (2017) further found that spare

borrowing capacities and conservative debt leverage positively affect firm recovery. Gittell et al. (2006) are more specific and relate to an example from the airline industry. In essence, those airlines that had sufficient cash to keep staff employed experienced a faster recovery than those that laid-off personnel to secure short-term liquidity. This example concludes that companies are advised to have enough funds available to keep key personnel employed during times of distress.

Tognazzo et al. (2016) found that for SMEs, high levels of profitability and financial slack are crucial to growth during recessions, while R&D investments are not. This finding stands in contrast to conclusions by Mudambi and Swift (2011), chapter 2.2.3, and Piekkola (2018) covered below.

Academic literature proves that companies are motivated to continue their R&D investments during challenging times (Brown & Petersen, 2015; Paunov, 2012). Brown and Petersen (2015) found that companies prefer to finance R&D activities over alternative capital investments. This preference is partly so strong that capital investments are only approved when no R&D projects compete for funds. In some cases, firms even "allow the stock of fixed assets to fall [in order] to stabilize R&D" (Brown & Petersen, 2015: 441).

While innovation is typically positively related to resilience (e.g., Adcock et al. (2014)), extreme levels of innovation have detrimental effects. As such, firm-specific crisis probability increases if technological coverage per patent rises above a sustainable level (Lee, Chen, & Su, 2018). Hence, the authors suggest focusing on a limited number of core technologies to remain able to act in challenging times.

A more nuanced study by Piekkola (2018) differentiates between the value of innovation and the value of intellectual capital. It suggests that traditional innovation has failed to compensate for dwindling manufacturing sector job losses but stresses the importance of intellectual capital for firm performance (Piekkola, 2018). According to the article, intellectual capital is particularly relevant for firms' ability to digitize their business processes. As such, Piekkola

(2018) argues that non-intellectual capital-producing firms experience a painful and costly adjustment process if value chains become digital.

Landini, Arrighetti, and Lasagni (2020: 466) connect to this idea and argue that intangible assets support organizational resilience through "resource and dynamic capability effects, which allow firms to develop adequate responses in the face of adverse and unexpected shocks." Causative is first and foremost firm's capability to flexibly adapt to new environmental conditions. At later stages in the recovery process, intangible assets support recovery only as long as external financing is associated with a relatively solid financial structure.

Firms that actively manage their intangible asset strategy carefully observe their economic value added (EVA) and market value added (MVA). Shakina and Barajas (2016) constructed three profiles with different levels of intangible asset intensity. They found that long-term financial investment commitments aggravate the condition of companies but prove to be financially beneficial in the long run. Worst performance has been found for companies with a moderate intangible asset intensity, as those "declined significantly in 2008-2009 and had not recovered from the crisis by 2012" (Shakina & Barajas, 2016: 769). This finding supports the idea that mediocre decisions without genuine commitment, clear focus, and a coherent strategy negatively affect firm recovery.

Since innovation and crisis management access similar resources, particularly finance and time, innovation collaboration is worth considering. Arslan, Golgeci, Khan, Al-Tabbaa, and Hurmelinna-Laukkanen (2021) and Liu, Beltagui, and Ye (2021) stress the positive features of innovation partnerships. Cooperations enable resource sharing, drive idea exchange, trigger reciprocal learning and create social value (Arslan et al., 2021; Lee et al., 2018). Gains in speed can be achieved as competing companies develop a specific product mutually, rather than individually, also with the expectation to mutually create something better than if each company had worked on its own (Liu et al., 2021).

Organizations with a high degree of combinative capabilities can better utilize growth-stimulated impulses from economic activities (Holtermann et al., 2021). Continuation of R&D activities during a crisis is not only dependent on capital availability but is also connected to past experiences. Amore (2015: 1574) found that "past experiences with innovation during recessions improve a firm's ability to invest in R&D when a new downturn hits." Again, this result is crisis-specific as innovation experiences from stable times do not contribute to crisis resilience (Amore, 2015). Similarly, after a downturn, patent outcomes and innovative efficiency are stronger if an organization collected innovation experiences in a previous crisis.

Lastly, academic research observes that market orientation became a standard and lost its differentiator characteristic (Frösén & Tikkanen, 2016). While a coherent market orientation in times of economic upturn still benefits performance, it does not help in challenging times anymore. The authors justify their finding that managerial attention to achieving market orientation distracts decision-makers from more important tasks such as economic performance and short-term survival (Frösén & Tikkanen, 2016).

To conclude this chapter, three points stand out. First, liquidity is a crucial ingredient for crisis resilience as it allows to fulfill short-term obligations, mid-term survival, and long-term growth. Second, intellectual capital is as significant as physical capital because the former will enable businesses to prepare for the post-crisis time. Third, research and innovation collaborations not only help companies to master the period of a downturn but also generate benefits for the overall economy and society.

Table 3: Literature overview on the category of assets & resources

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Adcock, C; Hua, XP; Mazouz, K; Yin, SX (2014)	Relationship between innovations and market reaction to negative news during the GFC 2008	*Research object: Stock market indices *Timespan: 2007 to 2012 *Geographic focus: Europe *N=27 stock indices *Data sources: Datastream	Economy performance (stock market index performance)	R&D strategy (R&D to GDP ratio, R&D personnel, patent count)	[n/a]	Secondary: empirical	*Index prices of highly innovative countries experience positive abnormal returns and lower risk following negative news announcements *For low innovative countries, the relationship is vice versa
Ahn, JM; Mortara, L; Minshall, T (2018)	Effects of openness in innovation on firm performance in times of distress	*Research object: Manufacturing companies *Timespan: 2006 to 2012 *Geographic focus: United Kingdom *N=480 firms, 1,440 observations *Data source: United Kingdom Community Innovation Survey (CIS)	Firm performance (turnover change)	R&D strategy (open vs. closed), employment cuts	[n/a]	Secondary: empirical (cluster analysis)	*Increasing firm's openness and peer collaboration enhance OR, as newer knowledge is acquired, which helps to identify growth opportunities *Three innovator types identified: closed innovators, open innovators, and austerity planners
Amore, MD (2015)	Innovation in downturns to improve firm position during the recovery period	*Research object: Manufacturing and service companies *Timespan: 1976 to 2006 *Geographic focus: USA *N=1,901 firms *Data sources: Compustat, USPTO	R&D expenditure	R&D strategy (expenditure)	[n/a]	Secondary: empirical	*Innovation experiences from prior crises improved firm's ability to invest in R&D when new crisis hits; innovation experiences in stable times, however, are not beneficial
Arslan, A; Golgeci, I; Khan, Z; Al-Tabbaa, O; Hurmelinna-Laukkanen, P (2021)	Importance of cross-sector partnerships, collaboration, and learning during times of distress	*Research object: Emerging markets *Timespan: 2020 *Geographic focus: Pakistan, Turkey, Nigeria	[n/a]	[n/a]	[n/a]	Conceptual	*Value of partnerships in times of distress is beneficial partly due to chances for adaptive learning *Inter-firm collaboration and resource sharing create social value and thus increase organizational resilience

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Brown, JR; Petersen, BC (2015)	Management of R&D and fixed investment during times of distress	*Research object: Public companies *Timespan: 2004 to 2010 *Geographic focus: USA *N=1,009 firms *Data sources: Compustat	R&D expenditure, capital expenditure	Firm performance (investment, sales, cash flow)	[n/a]	Secondary: empirical	*Firms with significant R&D expenditure use cash reserves to continue R&D during crises, while capital investments are typically reduced
Cruz-Castro, L; Holl, A; Rama, R; Sanz-Menendez, L (2018)	Reduction of R&D spending during times of economic distress	*Research object: Manufacturing and service companies *Timespan: 2008 to 2012 *Geographic focus: Spain *N=4,619 firms *Data sources: Spanish Technological Innovation Panel	Cancellation of innovation expenditure	Economy structure (size, regional innovation system, public funding)	Regional contexts	Secondary: empirical	*Adjustments to R&D expenditures are regionally heterogeneous and related to regional innovation system *Regional R&D support only reduces R&D abandonment rates in regions with strong system of knowledge exploitation
Ferrando, A; Marchica, MT; Mura, R (2017)	Financial flexibility as a buffer for liquidity shocks	*Research object: Public and private companies *Timespan: 1993 to 2010 *Geographic focus: Europe *N=289,839 firms, 1,598,899 firm-year observations *Data source: Amadeus	Financial flexibility	Firm performance (capital expenditure, cash flow, sales)	[n/a]	Secondary: empirical	*Financial flexibility allows to counteract liquidity shocks and enables future investment also in times of economic distress *Value of financial flexibility is higher for private, smaller, and younger firms
Frosen, J; Tikkanen, H (2016)	Implications of key strategic marketing constructs and performance after the GFC 2008	*Research object: Companies of/from various sizes, industries, and market positions *Timespan: 2008 to 2014 *Geographic focus: Finland *N=3,154 firms *Data sources: National administrated survey	Firm performance	Marketing strategy (market orientation, marketing-related business process capabilities)	Business cycle, business type	Secondary: empirical (factor analysis)	*Marketing performance measurement maintains its beneficial impact across business cycles *Market orientation is no longer a differentiation but a standard

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Gittell, JH; Cameron, K; Lim, S; Rivas, V (2006)	Impact of employee layoffs and financial reserves on post-crisis recovery	*Research object: Major U.S. airlines *Timespan: 1987 to 2005 *Geographic focus: USA *N=10 airlines	Organizational resilience (time to recovery)	Firm performance (employee layoffs, financial reserves, business model viability)	[n/a]	Secondary: empirical	*Post-crisis employee lay-offs due to cash shortages inhibited the recovery process, although personnel savings were intended to do the opposite *Thus, maintaining adequate financial reserves contributes to OR
Holtermann, L; Hundt, C; Steeger, J; Bersch, J (2021)	Impact of cluster externalities on economic performance	*Research object: Manufacturing and business service companies *Timespan: 2004 to 2011 *Geographic focus: Germany *N=16,000 firms *Data source: Mannheim Enterprise Panel, Creditreform	Firm performance (sales growth, FTE growth)	Firm performance (size, intellectual capital)	Knowledge spillover, within-cluster-variety	Secondary: empirical	*Firms with high degree of combinative capabilities better gain growth-stimulated impulses from within-cluster variety of economic activities *Benefits from within-cluster externalities quickly emerge to pre-crisis level if macro-economy recovers
Landini, F; Arrighetti, A; Lasagni, A (2020)	Benefit of intangible assets during and after an economic crisis	*Research object: Manufacturing companies *Timespan: 2006 to 2014 *Geographic focus: Italy *N=4,746 firms *Data sources: MET survey, AIDA-BVD	Firm survival	Intangible asset strategy	[n/a]	Secondary: empirical	*Intangibles directly reduce the probability of firm exit during the initial phase of a crisis *At later stages, beneficial effects of intangible assets are conditional on the firm's solid pre-crisis financial status
Lee, PC; Chen, SH; Su, HN (2018)	Technological resilience at the country level through patents	*Research object: OECD countries *Timespan: 1976 to 2015 *Geographic focus: OECD countries *N=35 countries, 4,466,192 patents *Data sources: USPTO	Technological resilience (crisis probability, crisis intensity, crisis duration)	Patent characteristics (collaboration, knowledge, diversity, legal protection)	[n/a]	Secondary: empirical	*Higher technological coverage leads to higher crisis probability *More original technology leads to higher crisis intensity *Interpersonal collaboration enhances chances of passing a crisis quicker

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Liu, W; Beltagui, A; Ye, SH (2021)	Faster product development in times of urgency through firms in the same ecosystem due to cooperation	*Research object: Health care product manufacturers *Timespan: 2020 and 2021 *Geographic focus: United Kingdom *N=80 firms *Data sources: Public information (websites, social media, press releases, etc.)	[n/a]	[n/a]	[n/a]	Primary: qualitative	*Ability to adapt design and manufacturing processes determines firm's role in its ecosystem *Resilient firms share common purposes and develop products in cooperation with peers
Piekkola, H (2018)	Intangible capital as a source of growth during times of distress	*Research object: European countries *Timespan: 2008 to 2013 *N=57 European industries in over 21 countries *Data source: Eurostat tables	Economy performance (mean group effects)	Intellectual capital (organizational capital, R&D, ICT)	[n/a]	Secondary: empirical	*Innovation failed to compensate for dwindling manufacturing sector and job losses, while broad intellectual capital (IC) offered a roadmap for recovery *Non-IC-producing service companies experienced painful adjustment to new wave of digitalization
Shakina, E; Barajas, A (2016)	Evaluation of intangible-intensive strategies in terms of their dynamics in pre-, in-, and post-crisis times	*Research object: European public companies *Timespan: 2004 to 2011 *Geographic focus: United Kingdom, Germany, France, Spain, Italy *N=1,600 firms *Data sources: Amadeus, Bloomberg	Intangibles strategy (economic value-added, market value-added)	Intangible asset strategy (innovative profile, conservative profile, moderate profile)	Crisis stage (pre, in, post)	Secondary: empirical	*LT investment commitments aggravate the condition of companies *However, intangible-intensive strategies provide firms with highly sustained performance in the LT
Tognazzo, A; Gubitta, P; Favaron, SD (2016)	Impact of organizational slack as a buffer for SMEs in crisis periods	*Research object: SMEs in traditional industries *Timespan: 2004 to 2010 *Geographic focus: Italy *N=1,206 firms *Data source: AIDA	Firm performance (sales growth, ROA)	Firm performance (profitability growth, financial slack, R&D investment)	[n/a]	Secondary: empirical	*For SMEs, high levels of profitability and financial slack are essential to secure reasonable growth during recessions; R&D investments are not

2.2.3 Actions & decisions

The category of actions & decisions contains 10 publications and deals with the topics of the company's identity, R&D management, business model, corporate social responsibility (CSR), and information, communication, technology (ICT) strategy, and decisions systems. These aspects have in common that individual organizations can adjust them flexibly and with short notice. Hence, any alterations have the power to influence crisis resilience, both positively and negatively. As such, wise and anticipatory decisions are essential.

Attentive organizations have abilities to recognize value, incorporate new information, and grasp new market developments quickly. Nowak (2021) refers to these skills as absorptive capacity and differentiates between potential absorptive capacity (PACAP) and realized absorptive capacity (RACAP). PACAP relates to capturing valuable ideas from the market; RACAP refers to transforming and exploiting new developments within the organization. In combination, RACAP and PACAP strengthen a firm's resilience to exogenous shocks through higher levels of strategic flexibility. In their study, Nowak (2021) observed strategic flexibility, operationalized through a questionnaire, and established RACAP as the mediator between the basic strategic flexibility to PACAP relationship.

Knowledge sharing and innovation openness determine long-term revenue growth in post-crisis times. Ahn et al. (2018) defined three types of innovators and found that a higher degree of innovation openness, e.g., through R&D partnerships, unlocks opportunities for enhanced, long-term firm performance.

Mudambi and Swift (2011) and Srinivasan et al. (2011) looked at actual R&D spending to better understand which level of expenditure is reasonable in crisis periods. While Srinivasan et al. (2011) conclude that – subject to moderating effects of market share, financial structure, and business model – companies spent an about right amount of money on R&D during the 2008 GFC, Mudambi and Swift (2011) advocate for active R&D management. Firms that

actively manage their R&D budgets benefit from shifting funds from financially unattractive to financially attractive projects. In consequence, firms grow stronger and more sustainable.

Economic crises can represent a trigger to break out into new directions. As such, potential lies in temporarily switching to new business models (Clauss, Breier, Kraus, Durst, & Mahto, 2022) or starting to shape – instead of adapt to – new markets (Nenonen & Storbacka, 2020). These options, also discussed by the research of Cucculelli and Peruzzi (2020) and Mayr et al. (2017), are enriched by qualitative perspectives. Clauss et al. (2022) argue that temporary business model innovation is particularly beneficial for SMEs and carries a high potential for long-term integration if it fits the original business model. To protect firm reputation and allow for a switchback, the innovated business model must not harm the existing one: neither from a brand nor from a revenue or cost perspective.

Nenonen and Storbacka (2020) even go one step further and suggest actively utilizing the crisis to shape the market. Their qualitative findings are based on experiences from the COVID-19 pandemic. Generating new opportunities during shocks appears beneficial for two reasons. First, ”as the stasis of the market system is interrupted, it forces the system into movement – and it requires less effort to nudge an already moving system in a specific direction” (Nenonen & Storbacka, 2020: 265). Second, “as deeply-rooted mental models are challenged during crises, any market-shaping initiative which promises a credible end to current instability with a new equilibrium will appeal to the natural human craving for stability” (Nenonen & Storbacka, 2020: 265). As such, the authors provide a qualitative basis that empirical research can further evaluate.

Relevant literature on the connection between resilience and strategic orientation focuses on corporate social responsibility (CSR) initiatives. Ortiz-de-Mandojana and Bansal (2016) found that social and environmental practices (SEPs) lead to lower volatility, higher long-term growth, and better survival rates. The authors justify their findings with SEPs helping to “quickly process [...] and respond [...] to environmental signals [...] and develop [...] flexible

resources that can be applied to a wide range of interchangeable alternatives" (Ortiz-de-Mandojana & Bansal, 2016: 1617). DesJardine et al. (2019) build on the prework of Ortiz-de-Mandojana and Bansal (2016) and introduce a differentiation between strategic social and environmental practices (SSEPs, long-term focused), and tactical social and environmental practices (TSEPs, short-term focused). Both have positive effects on resilience; however, their exact impact is differentiated. SSEPs reduce both severity of loss and time to recovery; TSEPs reduce time to recovery only. In general, the effects of SSEPs on time to recovery are comparably stronger. The authors explain their findings mainly by referring to interdependencies and connections to and between internal and external stakeholders.

Systemic crises typically create high uncertainty among many players: governments, financial markets, enterprises, and the population. The general sentiment is particularly negative if individual companies or specific industries are responsible for a crisis outbreak. One example is the banking sector which had significant contributions to the 2008 GFC. In light of this, Laidroo and Sokolova (2015) attempted to understand how CSR disclosure of international banks developed between 2005 and 2013. A thorough analysis of banks' CSR publications revealed that "banks had acknowledged the legitimacy gap and had taken steps to improve the situation" (Laidroo & Sokolova, 2015: 284). However, the authors also question whether some CSR measures were "related to stakeholder management attempts not necessarily reflecting improved CSR awareness and action" (Laidroo & Sokolova, 2015: 285). Hence, window-dressing is potentially an issue.

Bertschek, Polder, and Schulte (2019) look at firms' economic state and their ICT intensity to establish that an ICT focus softens crisis-related productivity losses and boosts process innovation during times of distress. They justify their findings with higher flexibility through easier reorganization of production processes. Firms that lag in adopting new technology are at risk of being driven out of the market. Firm size and intellectual capital strategy are additional determinants of firm performance.

Strategic information systems (SIS) enable companies to seize opportunities by creating competitive strategies in economically challenging times. Strategic information systems help companies to predict their use of prospector strategies in order to reduce the need to sacrifice efficiency for innovation (Yoshikuni & Albertin, 2018). Compared to traditional methods of forecasting business success, e.g., through the formulation of strategic guidelines, SIS can predict performance much better. Interestingly, the authors also found that an "adoption of SIS solutions [even] during economic crises can help firms to perform well" (Yoshikuni & Albertin, 2018: 2043). Hence, this finding underlines that there is no fixed cut-off point to introduce new control mechanisms.

Given that crises are a source of uncertainty, entrepreneurs need to embrace new decision-making approaches since traditional methods, such as investment evaluations, are incompatible with crisis-driven ambiguity. Petrakis, Kostis, and Kafka (2016) suggest a decision-making model through creative, strategic scenario thinking (CSST) and highlight the model's flexibility and its power to evaluate a larger number of options. Ultimately, decisions are expected to lead to future competitive advantages and make "enterprises or organizations sustainable under the new era of conditions that are going to prevail in the future" (Petrakis et al., 2016: 1911).

To conclude this chapter, three points stand out. First, an active R&D management during crises helps companies to focus as it guides firms to discontinue non-viable projects. Second, during crisis periods, the circumstances to adapt the current business model or shape new markets are favorable as customers are generally open to new opportunities. Third, CSR activities have significant power to create organizational resilience, while window-dressing attempts need to be addressed.

Table 4: Literature overview on the category of actions & decisions

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Bertschek, I; Polder, M; Schulte, P (2019)	Crisis performance of ICT-intensive vs. non-ICT-intensive companies concerning productivity	*Research object: ICT-intensive and non-ICT-intensive firms *Timespan: 2001 to 2010 *Geography: 12 countries *N=824 firms *Data source: Proprietary Micro Moments Database	Firm productivity	Firm performance (economic state, ICT intensity)	[n/a]	Secondary: empirical	*ICT-intensive firms were hit less hard concerning their productivity, in particular, service industry firms *ICT-intensive firms were more successful in introducing process innovation during times of distress
DesJardine, M; Bansal, P; Yang, Y (2019)	Influence of CSR measures - both tactical and strategical on organizational resilience	*Research object: Public companies *Timespan: 2008 to 2013 *Geographic focus: USA *N=963 firms *Data sources: CRSP, Compustat, KLD	Organizational resilience (stock price drop, time to recovery)	CSR strategy (tactical, strategical)	[n/a]	Secondary: empirical	*SSEPs reduce both severity of loss and time to recovery *TSEPs reduce time to recovery only *Effects of SSEP on time to recovery are stronger compared to those of TSEPs
Laidroo, L; Sokolova, M (2015)	Pattern of CSR disclosures after a systemic crisis	*Research object: International banks *Timespan: 2005 vs. 2013 *N=35 banks *Data source: Banks' CSR reports	[n/a]	[n/a]	[n/a]	Secondary: content analysis	*Sustained and increase CSR disclosure in banking sector increases both firm stability and global finance sector stability *Window-dressing attempts need to be carefully spotted by potential investors
Mudambi, R; Swift, T (2011)	R&D expenditure volatility indicated proactive R&D management	*Research object: Public, manufacturing companies *Timespan: 1997 to 2006 *Geographic focus: USA *N=10,996 firm-year observations *Data sources: U.S. Econ. Census	Firm performance (sales growth, ROA)	R&D strategy (expenditure volatility, corp. diversification)	[n/a]	Secondary: empirical	*Active R&D management observed through more volatility in R&D expenditure leads to higher firm growth *Relationship is weaker among firms with higher level of diversification and negative small firms
Nenonen, S; Storbacka, K (2020)	Utilization of crises to shape - instead of adapt to - new markets	[n/a]	[n/a]	[n/a]	[n/a]	Conceptual	*Crises support generation of new opportunities, as economic systems are more malleable during times of distress and as humans are more receptive to market-shaping activities because these fulfill people's needs for stability

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Nowak, R (2021)	Strategic flexibility and absorptive capacity in response to exogenous changes	*Research object: Hospitals, emergency department *Timespan: 2020 to 2021 *Geographic focus: USA *N=417 surveys from 101 emergency units in 100 hospitals *Data sources: Online survey	Strategic flexibility	Absorptive capacity (recognize value, incorporate new information)	Realized absorptive capacity (RACAP), firm performance (mediator)	Primary: empirical	*Absorptive capacity supports development of strategic flexibility as it expands firm's ability to recognize importance of critical exogenous events
Ortiz-de-Mandojana, N; Bansal, P (2016)	Contribution of social and environmental practices to long-term organizational resilience	*Research object: Companies with social and environmental engagement *Timespan: 1994 to 2008 *Geographic focus: USA *N=242 firms *Data sources: Compustat, KLD	Financial volatility, firm performance, firm survival	CSR strategy (social and environmental engagement)	[n/a]	Secondary: empirical	*SEPs lead to lower financial volatility, higher LT growth, and better survival rates because of SEP's buffer function and ability to attract customers
Petrakis, PE; Kostis, PC; Kafka, KI (2016)	Influence of GFC on the development of entrepreneurship	[n/a]	[n/a]	[n/a]	[n/a]	Conceptual	*Uncertainty and new era conditions require entrepreneurs to engage in scenario analysis and creative thinking to identify and realize new opportunities
Srinivasan, R; Lilien, GL; Sridhar, S (2011)	Determination of appropriate levels of R&D and advertising spend during recessions	*Research object: Public companies *Timespan: 1969 to 2008 *Geographic focus: USA *N=10,580 firm-year observations *Data sources: Compustat, CRSP	Firm performance (profits, stock return)	R&D strategy (expenditure)	Market share, financial leverage, business model	Secondary: empirical	*Overall, companies spent an about right amount on R&D and advertising during crises *Strong R&D and advertising underspending prevalent in B2C firms
Yoshikuni, AC; Albertin, AL (2018)	Impact of strategic information systems on an organization's survival in times of economic distress	*Research object: Public and private companies *Geographic focus: Brazil *N=389 firms *Data sources: Survey	Strategic orientation, firm performance	Strategic orientation	Firm size	Primary: empirical	*Strategic information systems (SIS) promote capacity and flexibility to create competitive strategies in times of distress *SIS-using firms predict performance better than strategic orientation can

2.2.4 Skills & capabilities

The category of environment & situation contains 10 publications and deals with the topics of intangible asset investments, CEO's personalities, and workforce's capabilities. These aspects have in common that they deal with the soft skills of firms' human assets and can unfold positive or negative effects in stable and unstable times.

Looking at the value of intellectual capital, Pereira, Budhwar, Temouri, Malik, and Tarba (2021) and Ahn et al. (2018) examined firm-level investments into intangible assets, e.g., learning and development, value systems, open-mindedness, continuous improvement, and critical thinking. Through adequate training, leaders, managers, and employees can remain agile and make wise decisions in economically challenging times. Pereira et al. (2021) encompass a conceptual framework for analyzing the mediating role of strategic agility in the intangible assets to technological performance relationship and motivate fellow researchers to add empirical support.

Organizational resilience is not only driven by the management team's actions and decisions but is also influenced by leaders' personalities and character traits. Duchek (2018) and Sabatino (2016) examined biographies of entrepreneurs and pursued in-depth interviews to synthesize that situation, and process-related factors are essential for entrepreneurial resilience. Situational factors encompass parents' behavior during childhood and the entrepreneur's own experiences. A respectful and supportive family background helps develop character traits for a high need for achievement, whereas rejection, punishment, and controlling parenting hurt individual resilience (Duchek, 2018). Process-related factors encompass learning and work attitudes. Experience of success and failure during an entrepreneur's first projects positively affects the founder's ability to recognize emerging risks and opportunities. Especially the process-related factors help entrepreneurs to develop crisis management skills such as anticipating new

developments, managing shareholder relationships, and communicating with internal and external stakeholders (Sabatino, 2016).

Apart from proper communication, management teams need to make wise decisions to get the company back on track. Learning goal orientation has been identified as one critical contributor to sustained and stable performance in times of distress (Battisti et al., 2019). Causative for the positive impact are management teams' "adaptive response patterns associated with learning goal orientation that help firms to sustain their performance" (Battisti et al., 2019: 47). According to the authors, learning is not limited to experience-based learning or formal training but can also happen through exchange with business partners and stakeholders, e.g., local authorities, banks, and suppliers.

Since speed is critical in times of economic distress, the task of making decisions and steering the business is even more naturally assigned to executives and leaders. By holding a prominent position with frequent exposure to internal and external stakeholders, authenticity has been identified as a critical character trait for decision-makers that simultaneously influences a firm's CSR commitment (Fox, Davis, & Baucus, 2020). The authors conclude that "highly authentic leaders are more likely to honor [...] CSR commitments, such that firms are more positive, ethical, moral, relationship-oriented, honest, consistent, and transparent with its stakeholders" (Fox et al., 2020: 2226). While these character traits are beneficial in times of uncertainty and help become more organizationally resilient, Fox et al. (2020) introduce an inflection point at which CSR activities are either continued or ceased. The decision to continue or cease CSR engagement depends on the firm's ability to adjust its business model and generate sufficient income for CSR investments. The findings of Fox et al. (2020) underline a high degree of interdependencies between entrepreneurs, public appearance, and crisis resilience.

Hughes, Morgan, Hodgkinson, Kouropalatis, and Lindgreen (2020) add that executives need to constantly develop their improvisation skills to maintain vigilance in strategic decision-making and ensure that unexpected issues do not repeat during recovery.

Buyl et al. (2019) focus on the impact of CEO character traits, specifically on narcissism. They found that CEO narcissism increases the riskiness of banks' policies unless board monitoring is effective. As such, organizational governance takes a moderator role. The riskiness of policies causes sample banks to recover slower. Hence, narcissistic CEOs – as well as greedy ones – harm crisis mitigation. Greedy CEOs show a "diminished concern for the welfare of their firm's stakeholders and tend to forgo long-term investments that require short-term financial sacrifices" (Sajko et al., 2020: 28). Since CEO greed negatively affects CSR engagement, organizational resilience, defined as severity of loss and time to recovery, suffers significantly. CEO bonus and restricted stock moderate the relationship.

Further, managers need to balance their attention between exploration and exploitation in order to meet environmental conditions (Walrave et al., 2017). During times of economic downturn, managers should focus on exploration, whereas economic upturns demand an exploitation focus. However, the authors note that "the attentional balance between exploitation and exploration is even more difficult to manage than originally anticipated" (Walrave et al., 2017: 1155).

However, not only management team skills are crucial in mastering the crisis, but also employee capabilities can unleash benefits in times of distress. According to Maley (2019), investments in employee capabilities, i.e., through dedicated training, allow firms to adapt to challenging times. A capable workforce contributes irreversible quality to the firm that eventually helps to meet both short-term and long-term strategic objectives despite economic distress. However, it is vital to acknowledge that such training and education cannot happen instantly. Therefore, it needs to be built in the long run so that companies understand employee upskilling as a long-term investment rather than a short-term expense.

To conclude this chapter, three points stand out. First, personality, childhood, and experiences contribute to a leader's personal crisis resilience and ability to control the company's fate during times of distress. Second, negative character traits such as narcissism or greed

negatively affect crisis resilience through, e.g., CSR disengagement. Third, investments in the workforce's skills should be understood as a long-term asset and not as a short-term expense.

Table 5: Literature overview on the category of skills & capabilities

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Battisti, M; Beynon, M; Pickernell, D; Deakins, D (2019)	Influence of learning on SME resilience	*Research object: Manufacturing and service SMEs *Timespan: 2007 to 2011 *Geographic focus: New Zealand *N=245 firms *Data sources: Survey	Organizational resilience (stability, survival)	Learning mechanisms (goal orientation, way of knowledge acquisition)	[n/a]	Secondary: empirical (cluster analysis)	*Higher levels of owner-manager learning goal orientation lead to both more sustained and stable performance and better rates of survival; lower levels cause the opposite
Buyl, T; Boone, C; Wade, JB (2019)	Investigation of how CEO narcissism impacts organizational risk-taking and organizational resilience	*Research object: Banks *Timespan: 2006 to 2014 *Geographic focus: USA *N=92 CEOs *Data sources: Compustat, letters to shareholders	Organizational resilience (stock price drop, time to recovery)	CEO narcissism, riskiness of policies	Corporate governance	Secondary: empirical	*Before the shock, CEO narcissism increases riskiness of bank's policies; level of riskiness damps when board monitoring is effective *Banks with narcissistic CEOs recovered slower
Duchek, S (2018)	Influence of situational and process-related factors on entrepreneurial resilience	*Research object: Biographies of entrepreneurs *Geographic focus: United Kingdom, USA *N=8 biographies *Data sources: Biographies	[n/a]	[n/a]	[n/a]	Literature review	*Entrepreneurial resilience emerges through situational and process-related factors *Entrepreneur's first projects help to build risk and opportunity recognition skills, thus strengthening resilience
Fox, C; Davis, P; Baucus, M (2020)	Relationship between CSR, authentic leadership, and business model flexibility during times of distress	[n/a]	[n/a]	[n/a]	[n/a]	Conceptual	*Authentic leaders and flexible BM help to strengthen stakeholder engagement during crises *CSR is highly honored until an inflection point at which firms either keep or cease their CSR commitment

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Hughes, P; Morgan, RE; Hodgkinson, IR; Kouropalatis, Y; Lindgreen, A (2020)	Improvisation Readiness Index Score (IRIS) determines crisis readiness	[n/a]	[n/a]	[n/a]	[n/a]	Conceptual	*Strategic improvisation is not inherently good/bad, but it can equip firms and executives to manage crises more efficiently *Key characteristics to manage crises: rapid decision speed, taking action, and strategic flexibility
Maley, JF (2019)	Benefits of employee capabilities in times of financial austerity	*Research object: Academic theories	[n/a]	[n/a]	[n/a]	Conceptual	*Investment in employee capabilities, i.e., flexibility and learning, helps firms to adapt and change in times of distress *Capable workforce contributes irreversible quality to the firm, eventually helping to meet strategic objectives despite austerity
Pereira, V; Budhwar, P; Temouri, Y; Malik, A; Tarba, S (2021)	Investigation of investments made by multinationals in intangible assets and consequential benefits in times of distress	*Research object: Multinationals in IT and business process outsourcing sector *Timespan: 2007 to 2017 *Geographic focus: India *N=225 firms *Data sources: ORBIS	Economy performance (total factor productivity)	Intangible asset strategy (investments)	Strategic agility	Secondary: empirical	*Sustained investments in intangible assets, e.g., learning and development, value systems, open-mindedness, continuous improvement, critical thinking, lead to improved performance in IT firms
Sabatino, M (2016)	Measuring the resilience of entrepreneurs in manufacturing firms	*Research object: Manufacturing companies *Timespan: 2012 to 2013 *N=30 interviews *Data sources: In-depth interviews	[n/a]	[n/a]	[n/a]	Conceptual	*Factors of resilient enterprises include organizational structure, e.g., cost structure, timeliness, anticipation, and relationship with markets, e.g., customer focus, product focalization, quality management, geographic focus
Sajko, M; Boone, C; Buyl, T (2021)	Influence of CEO greed on CSR and organizational resilience	*Research object: Public companies *Timespan: 2003 to 2007 *Geographic focus: USA *N=301 CEOs *Data sources: CRSP, Compustat, KLD	Organizational resilience (stock price drop, time to recovery)	CEO greed	CEO bonus, restricted stock	Secondary: empirical	*Firms that invested in CSR prior to the crisis experience higher recovery rates *Combination of intrinsic and extrinsic motives shapes CEO's inclination to build and profit from strong stakeholder relations

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Walrave, B; Romme, AGL; van Oorschot, KE; Langerak, F (2017)	Shifts in managerial attention during times of distress	*Research object: IT companies *Timespan: 2006 to 2010 *Geographic focus: Europe, USA *N=86 firms, 1,720 observations *Data sources: Thomson ONE Banker, annual letters to shareholders	Firm performance (profit margin)	Innovation strategy (exploration to exploitation ratio)	Environmental change	Secondary: empirical	*Navigating an economic downturn (upturn) requires managerial attention to exploration (exploitation) *Thus, managers need to distribute their attention between exploration and exploitation to meet environmental conditions

2.2.5 Resilience & performance

The category of resilience & performance contains 13 publications and deals with the topics of the interplay between resilience and performance, general resilience-building factors, crisis response options, and meta papers on organizational resilience. This chapter concludes the literature review. As organizational resilience and firm performance show strong dependencies, they are combinedly reviewed. From a conceptual perspective, organizational resilience [5.1] and firm performance [5.2] represent the combined outcome of elements [1] to [4]. Both organizational resilience and firm performance influence the state and constitution of [2] assets & resources and [3] skills & capabilities.

Prior research often categorized companies as either resilient or vulnerable, but according to Herbane (2019), differentiation is more nuanced. As such, they name four types of firms: attentive interventionists (high level of formalization in strategic and resilience planning), light planners (limited level of formalization in strategic and resilience planning), rooted strategists (high level of formalization in strategic planning, low level of formalization in resilience planning), and reliant neighbors (low level of formalization in strategic planning, high level of formalization in resilience planning). They further put forward that crises are forms of the regular business cycle that cannot or should not be seen as separate, exceptional periods.

Both Minichilli et al. (2016) and Salvato et al. (2020) agree that family firms perform significantly better than non-family firms or publicly listed companies due to social resources. These include “interpersonal relationships among family members with coherent goals, [...] close collaboration of family members to keep transgenerational control, [and sustainable] connections among family, firm, local community and government systems [...]” (Salvato et al., 2020: 596). Interestingly, the family firm performance superiority does not manifest in times of stable business (Minichilli et al., 2016). Hence, the direct transfer of findings across different stages in the business cycle is inadequate.

Martin-Rios and Pasamar (2018) connect to this idea and identified three strategic archetypes that all show resilience in the aftermath of a crisis. First, cost-oriented firms consider and prefer employment and innovation reduction. Second, commitment-to-expansion firms invest to enter new and extend existing markets. Third, resource-balancing firms implement complementary actions, e.g., reducing labor costs and increasing innovation expenses. As supported by other researchers (e.g., Gittell et al. (2006)), the commitment-to-expansion strategy specifically ensures long-term survival and business growth (Martin-Rios & Pasamar, 2018).

A highly granular level of detail for suitable response strategies is offered by Margherita and Heikkilä (2021). The authors identified 77 activities that companies pursued during the COVID-19 pandemic and grouped them into five areas, e.g., operations and value systems, customer experience and support, workforce and human capital, leadership and change management, or community and social engagement. Ultimately, Margherita and Heikkilä (2021) conclude that crucial success factors for effective crisis response are agile processes, technical reserves, business analytics, and visionary leadership.

In times of economic distress, firms are advised to define competitive priorities to master micro- and macroeconomic challenges. Bouranta and Psomas (2017) analyzed manufacturing and service firms and found that quality, delivery, cost, innovation, and customer focus are decisive factors for competitive success. In contrast, the factor of flexibility – comprising features such as product assortment, volume adjustments, and design improvement – does not find support. From the authors' perspective, some of those characteristics are already reflected in the customer focus feature.

Morrish and Jones (2020) approach the topic of entrepreneurial behavior from a conceptual perspective and unite entrepreneurial actions with consequential marketing behavior. The ultimate output is a comprehensive post-disaster recovery framework. According to the work of Morrish and Jones (2020), decisions to relocate the business, inject financial capital, and create or adapt the business model are inevitably linked to opportunity seeking, resource

organizing, customer value creation, and risk acceptance. Their research at the interface of entrepreneurial actions and marketing behavior is unique as they provide an integrated view of resilience-building factors.

Besides a decision on how to master a crisis from a strategical perspective, i.e., business model adjustment (e.g., Cucculelli and Peruzzi (2020); Mayr et al. (2017)) or investment shifts (e.g., Brown and Petersen (2015)), management teams also need to decide on how to deal with the new, crisis situation operationally. In some cases, this may lead to ceasing business activity. Mithani and Kocoglu (2020) found that organizations can choose between four options: hypervigilance (freeze), exit (flight), growth (fight), and dormancy (fright). The exact response is informed by the interplay between slack and routines. However, a decision should be taken early as survival-critical resources deplete with time.

Extensive literature underlines the positive relationship between entrepreneurial behavior – often operationalized through Covin and Slevin‘s (1989) construct of entrepreneurial orientation – and firm performance (e.g., Rauch et al. (2009); Soares and Perin (2019)). Building on own and foreign publications, Lumpkin and Dess (1996; 2001) enrich the literature on the EO-performance relationship through a wide range of interactions. Organicness, integration of activities, environmental generosity (all mediators), and management team characteristics (moderator) constitute contingent effects on firm performance (Lumpkin & Dess, 1996). Environmental dynamism and hostility, as well as industry stage (introduction, growth, maturity, decline), represent further alterations of the basic EO-performance connection (Lumpkin & Dess, 2001). Lumpkin and Dess (2001) further present the unique contributions of proactiveness and competitive aggressiveness on firm performance: proactiveness is strongly related to all sales growth, return on sales, and profitability, while competitive aggressiveness is negatively related to sales growth and only weakly and statistically insignificantly, to return on sales and profitability.

The traditional entrepreneurial orientation construct consists of five sub-dimensions, i.e., autonomy, competitive aggressiveness, innovativeness, proactiveness, and risk-taking (Covin & Slevin, 1989). Over time, researchers extended the original concept to fit their research needs and keep up with new developments. As such, the EO measure has been operationalized quite differently but interestingly with a high and consistent degree of robustness (Rauch et al., 2009). Building on these findings, the authors propose to expand research by investigating the causal direction between EO and performance, determining antecedents and covariates, and examining the role of additional moderators and mediators. Soares and Perin (2019: 156) summarize that the "link between EO and organizational performance is stronger for multi-item (vs. single-item) performance and for revenue-based performance measures" and weaker for cost-based measures. The identification of mediators such as learning orientation and innovativeness completes the analysis.

Xu, Wang, Wang, and Skare (2021) provide a literature overview on the combined topics of entrepreneurship and crisis. They see an increase in research interest, not so much in terms of (high quality) journal publications as in terms of mediocre conference proceedings. From a content perspective, relationships between entrepreneurship, crisis, innovation, and management are in focus, while more complex interdependencies are not covered. Xu et al. (2021) motivate researchers to push for high qualitative publications, specifically on crises of international significance.

Articles of Hillmann and Guenther (2021) and Linnenluecke (2017) are traditional meta papers that summarize the most influential articles and research streams on organizational resilience. Both agree that research on organizational resilience is currently quite fragmented. Researchers apply or refer to various concepts and operationalizations or cannot even conform to one commonly used definition (Hillmann & Guenther, 2021). While Linnenluecke (2017) identified five different research streams, i.e., organizational responses to external threats, organizational reliability, employee strengths, adaptability of business models, and design

principles to reduce supply chain vulnerabilities, Hillmann and Guenther (2021) synthesized a set of antecedents, i.e., slack resources, innovations, networks, and absorptive capacity. Both authors eventually stress that more empirical research is required in operationalizing and measuring or detecting and activating resilience, and evaluating interdependencies and contingences between different research streams (Hillmann & Guenther, 2021; Linnenluecke, 2017).

To conclude this chapter, three points stand out. First, although resilience and performance often go hand in hand, literature discusses several setups where the direct connection does not hold. Accordingly, researchers should be cautious when directly deriving organizational resilience from firm performance. Second, the authors identified several frameworks for crisis response, with some having a more general and others having a more crisis-specific focus. Third, to date, literature examined many basic relationships between influential factors and organizational resilience. However, more complex interdependencies represented by moderators and mediators lack high qualitative journal coverage.

Table 6: Literature overview on the category of resilience & performance

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Bouranta, N; Psomas, E (2017)	Competitive priorities between service and manufacturing firms during an economic crisis	*Research object: Manufacturing and service companies *Timespan: 2012 to 2015 *Geographic focus: Greece *N=298 firms *Data sources: Questionnaire	[n/a]	Competitive priorities (quality, customer, cost, delivery, innovation)	[n/a]	Primary: empirical (factor analysis)	*Competitive priorities consist of five latent constructs: quality, delivery, cost, innovation, and customer focus
Herbane, B (2019)	Examination of how SMEs act to achieve growth and enhance resilience against operational interruptions	*Research object: SMEs *Timespan: late 2014 *Geographic focus: United Kingdom *N=256 *Data source: Questionnaires	[n/a]	Crisis response (strategic formalization, resilience formalization, location, external crisis events, personal networks)	[n/a]	Secondary: empirical (cluster analysis)	*Companies are not either resilient or vulnerable, but differentiation is more nuanced *Four types exist: attentive interventionists, light planners, rooted strategists, reliant neighbors
Hillmann, J; Guenther, E (2021)	Systematic review of organizational resilience literature covering conceptual and operational issues	*Research object: Academic publications *N=124 journal articles, 3 books *Data sources: 71 empirical, 38 conceptual, 15 theoretical; 91 qualitative, 35 quantitative	[n/a]	[n/a]	[n/a]	Literature review	*Conceptualisation and measurement of OR remain fragmented *OR encompasses dimensions of flexibility, change adaptability, buffering capacity *Antecedents of OR include slack, innovation, networks, absorptive capacity
Linnenluecke, MK (2017)	Identifying research streams of organizational resilience and isolating current status	*Research object: Academic publications *N=339 papers, books, and book chapters across 133 publication sources *Timespan: 1977 to 2014	[n/a]	[n/a]	[n/a]	Literature review	*Five OR research streams: crisis response, organizational reliability, employee strength, BM adaptability, SCM *Current state in OR research: different conceptualizations, different operationalizations

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Lumpkin, GT; Dess, GG (1996)	Relationship between EO and firm performance	[n/a]	Firm performance	Entrepreneurial orientation	Organicness, integration of activities (mediator), top management team characteristics (interaction)	Conceptual	*EO drives firm performance; environmental and organizational factors act as moderators *Organicness, integration of activities, environmental munificence, and management team characteristics present equivalent, contingent effects on firm performance
Lumpkin, GT; Dess, GG (2001)	Relationship of EO subdimensions proactiveness and competitive advantage on firm performance	*Research object: Business owners *N=124 responses from 94 firms *Data sources: survey	Firm performance (sales growth, return on sales, profitability)	Entrepreneurial orientation (proactiveness, competitive aggressiveness)	Environment (dynamism, hostility), industry stage (introduction, growth, maturity, decline)	Primary: empirical (factor analysis)	*Competitive aggressiveness and proactiveness are distinct EO dimensions; both make unique contributions to firm performance *Proactiveness is beneficial for introduction and growth stage and in dynamic and hostile environments
Margherita, A; Heikkila, M (2021)	Impact of emergencies on business continuity and definition of response strategies	*Research object: World-leading companies *N=50 firms *Data source: Companies' web pages and social media posts	[n/a]	[n/a]	[n/a]	Secondary: content analysis	*Key success factors for crisis response are agile processes, technical reserves, business analytics, visionary leadership, and diversified and modular product/service portfolio
Martin-Rios, C; Pasamar, S (2018)	Strategic adoption of service firms in response to the economic crisis	*Research object: Service companies *Timespan: 2008 to 2016 *Geographic focus: Europe *N=97 firms *Data sources: EU Industrial R&D Investment Scoreboard	[n/a]	Crisis response (R&D investments, M&A actions, employment evolution)	[n/a]	Secondary: empirical (cluster analysis)	*Commitment-to-expansion strategy ensures LT survival and profit, sales, and market capitalization growth – in difference to a cost-oriented strategy

Author(s) (Year)	Main theme	Sample characteristics	Main DVs	Main IVs	Main Mod/Med	Study type	Key findings
Mithani, MA; Kocoglu, I (2020)	Options of business (dis-)continuation during times of distress	[n/a]	[n/a]	[n/a]	[n/a]	Conceptual	*Organizations choose between four options when faced with threads: hypervigilance, exit, growth, or dormancy *Respective responses depend on interplay between slack and routines *Quick decisions reduce depletion of resources
Morrish, SC; Jones, R (2020)	Influence of entrepreneurial marketing on business recovery	*Research object: Hospitality SMEs *Timespan: 2010 to 2018 *Geographic focus: Christchurch, Australia *N=12 firms *Data sources: In-depth interviews	[n/a]	[n/a]	[n/a]	Primary: qualitative	*Entrepreneurial crisis reaction includes: relocation of business, financial injection, business model innovation *Consequential marketing actions include: opportunity seeking, resource organizing, customer value creation, risk acceptance
Rauch, A; Wiklund, J; Lumpkin, G; Frese, M (2009)	Correlation between EO and performance measures	*Research object: Academic publications *N=53 samples from 51 studies, 14,259 firms	Firm performance (growth, profitability), entrepreneurial orientation	Entrepreneurial orientation	Firm size, industry, perceived and archival financial performance	Secondary: empirical	*Correlation between EO and performance is moderately large and robust to different operationalizations of critical constructs and cultural contexts *EO construct offers high potential for additional research in terms of antecedents, consequences, moderators, mediators, and relationships different from classical firm performance
Soares, MD; Perin, MG (2020)	Analysis of the relationship between EO and organizational performance	*Research object: Academic publications *Timespan: 1989 to 2014 *N=80 samples from 78 studies; 19,514 cases *Data sources: EBSCO, Web of Science, JSTOR	Firm performance	Entrepreneurial orientation	Learning orientation, innovation	Literature review	*EO has a direct and positive impact on organizational performance *Effect stronger for multi-item and revenue-based performance measures *Learning orientation and innovation have mediation effects
Xu, ZS; Wang, XD; Wang, XX; Skare, M (2021)	Identification of research stream on entrepreneurship and crises	*Research object: Academic publications *Timespan: 1984 to 2020 *N=1,044 documents *Data sources: Web of Science	[n/a]	[n/a]	[n/a]	Literature review	*Conference contributions numerically more present than journal publications *Topic development with clear shift from general to specific, with tendency to evaluate present crises

2.3 Research gap and research questions

The literature review reveals some critical shortcomings at the interface of organizational resilience, innovation, and entrepreneurship and thus opens up space for additional research. I discuss opportunities for generating new and relevant insights from four perspectives: content-related perspective, methodology-related perspective, time-related perspective, and quality-related perspective. Based on these four, I will formulate three super- and six subordinate research questions that will provide the frame and guide the setup of my academic studies.

Content-related perspective. The literature review reveals content-related gaps in the combined topic of innovation, entrepreneurship, and resilience. While an analysis of author and Web of Science assigned keywords illustrates that each topic on its own is well covered by academic literature, the combination lacks attention. My sample of 62 core articles contains only two empirical papers that deal with the combined topic of organizational resilience and innovation (i.e., Lee et al. (2018); Shakina and Barajas (2016)) and two other empirical papers that deal with the combined topics of organizational resilience and entrepreneurial orientation (i.e., Alonso-Dos-Santos and Llanos-Contreras (2019); Iacobucci and Perugini (2021)). This impression is confirmed by Linnenluecke (2017: 14), who states that "resilience research is fragmented across several research streams [potentially because] resilience research has often been motivated by a particular set of circumstances."

Linnenluecke (2017) further motivates researchers to answer questions like "Can resilience capacities be 'dual use' and ensure resilience against several types of extreme events?", "How do certain capacities (i.e., resources, structures, processes) lead to resilience, and what is their relative importance?" and "How is the level of loose coupling and slack resources related to resilience?" Directions of Rauch et al. (2009) on the topic of entrepreneurial behavior conform with Linnenluecke's (2017) research agenda on innovation: "We strongly encourage future research to address whether the characteristics [of entrepreneurial orientation] that lead to

higher performance among [crisis] surviving businesses are also associated with a higher risk of failure" (Rauch et al., 2009: 781).

Shifting from explicit calls for research to actual gaps identified within the literature framework (Figure 13), it turns out that academic coverage of crisis resilience misses details and modes of action. Duschl (2016) found that the larger (macro-)economy around an organization contributes to resilience but admits that the direction of causality remains unclear. Clauss et al. (2022), Mayr et al. (2017), and Mzid et al. (2019) underline that business model innovation, USP adaptation, and social capital availability are prominent options for SMEs to master adverse situations but do not constitute whether this equally holds for MNCs (multinational corporations). The benefits of financial slack and liquidity are apparent (e.g., Ferrando et al. (2017); Gittell et al. (2006); Tognazzo et al. (2016)), but it remains unclear if pre-crisis financial excess should be invested in innovation and entrepreneurial activities, or put aside as slack for times of distress. Ahn et al. (2018) and Arslan et al. (2021) mention the positive impact of collaboration during economic downturns, while neither of the two empirically verified the effects. Articles categorized as [3] actions & decisions address the topics of innovation, entrepreneurship, and communication in a crisis context but explicitly focus on the in- and not pre-crisis period (e.g., Laidroo and Sokolova (2015); Mudambi and Swift (2011); Srinivasan et al. (2011)). The pre-crisis time, however, actually deserves particular attention as this period allows for making provisions for the next economic shock. Focusing on the management team and the workforce in light of their character traits and entrepreneurial drive, literature has so far looked at influencing factors with a negative connotation, e.g., greed or narcissism (Buyl et al., 2019; Sajko et al., 2020) and on education and training from a cost perspective. Instead, it appears beneficial to consider newly acquired skills and personal experiences as investments, which carry particular benefits in challenging times. Lastly, although conceptually and operationally closely connected, firm performance and organizational resilience are not identical. Amore (2015) and Salvato et al. (2020) argue that identical resources do not necessarily trigger the

same benefits in stable vs. unstable times. Accordingly, additional research is necessary to develop a more nuanced perspective.

Methodology-related perspective. The literature review reveals methodology-related gaps in the combined topic of innovation, entrepreneurship, and resilience. The measure of innovation orientation has been operationalized in various ways, but the majority of core papers focus on R&D expense data only (e.g., Amore (2015); Mudambi and Swift (2011); Srinivasan et al. (2011)). Utilization of measures such as R&D personnel and patent counts (Adcock et al., 2014) or R&D openness (Ahn et al., 2018) are rare exceptions. Hillmann and Guenther (2021), Linnenluecke (2017), and Rauch et al. (2009) uniformly invite researchers to statistically enrich the basic IV-to-resilience relationships by introducing interactions, e.g., moderators and mediators. This call for research fits my observation concerning the use of moderators and mediators: only 14 out of 62 core papers (23%) focus on interaction effects. As noted earlier, organizational resilience is oftentimes determined by measures resembling firm performance. This is not an issue per se but raises the question of whether there are superior options. As such, Linnenluecke (2017) suggests widening perspectives and considering and comparing alternative or multiple operationalizations of organizational resilience to expand knowledge. Lastly, I observed that larger population sizes are still uncommon. More than 55% of articles are based on samples smaller than 1,001 observations (Figure 9).

Time-related perspective. During the last 50 years, economies had to deal with a variety of economic downturns, such as the OPEC Oil Price Shock (1973), the International Debt Crisis (1982), the Black Monday (1987), the Asian Crisis (1997), the dot.com bubble (2000), the 9/11 attacks (2001), and the Great Financial Crisis (GFC, 2008). Considering the more recent crises, i.e., those from the 2000s onwards, academic research keeps abreast (Linnenluecke, 2017). Both the 2008 GFC and the 2019 COVID pandemic found their way into the literature (Figure 5). While additional research on the 2019 COVID pandemic is likely to be published soon, papers on the 2022 Russian attacks on Ukraine are highly expected. They may deal with topics

such as energy and raw material price fluctuations, food shortages, inflation, and supply chain risks. Apart from current crisis-related developments, there is a high general interest in research on organizational resilience, as more than 90% of relevant literature has been published in the past decade (Figure 5).

Quality-related perspective. The literature review reveals quality-related gaps in the combined topic of innovation, entrepreneurship, and resilience. By evaluating this dissertation's literature basis of 62 core articles, only a mere 23% are from A+ (2 articles) and A (12) journals. The remainder (48 articles, 78%) has been published by academic journals rated B or lower. The finding that the "overall quality level of [...] publications is moderate" has been confirmed by Xu et al. (2021).

To conclude, I identified research gaps in four dimensions, i.e., content, methodology, time, and quality, and express my aspiration to address these in my academic work. Hence, my overall research theme reads as follows:

Superior research theme: *How do innovation assets, entrepreneurial actions, and communication strategies drive crisis resilience under firm-specific conditions?*

For additional granularity, I break down this overall theme into three principal research questions that are accompanied by two more concrete sub-questions each.

First, I address the relationship between innovation and organizational resilience and employ a selection of measures to determine a firm's innovation activity. As such, I relate to the publications of Lee et al. (2018) and Shakina and Barajas (2016) but extend their perspectives by contingency effects. Thus, my first set of research questions reads as:

Research question 1 (RQ 1)*: How does pre-crisis innovation activity contribute to organizational resilience under consideration of challenging pre-crisis experiences?*

RQ 1a: Does a strategic emphasis on innovation influence how organizations experience the post-crisis period?

RQ 1b: Do challenging, pre-crisis profitability conditions alter the influence of innovation on resilience in a beneficial or harmful way?

Second, I address the relationship between entrepreneurial orientation and short-term market reaction, the latter I positioned as an alternative measure for resilience. As such, I respond to Hillmann and Guenther (2021), Linnenluecke (2017), and Rauch et al. (2009) in broadening the measurement and understanding of organizational resilience. I further build on prior research from Alonso-Dos-Santos and Llanos-Contreras (2019) and Iacobucci and Perugini (2021) but extent their findings by focusing on a different methodology and on contingency effects. Thus, my second set of research questions reads as:

Research question 2 (RQ 2): *How does an entrepreneurial attitude influence short-term market reactions given differences in the financial structure?*

RQ 2a: Do organizations with an entrepreneurial orientation show superior or inferior short-term stock market performance at the outbreak of the crisis?

RQ 2b: Does a higher degree of debt financing alter the influence of entrepreneurial orientation on instant stock-market reactions in a beneficial or harmful way?

Third, I introduce the topic of communication strategy as a consequential next step. Given that the studies answering RQ 1 and RQ 2 are based on publicly traded companies, stakeholders in general and capital investors in specific play a major role as they influence stock prices through buying and selling shares. One goal of an organization's successful shareholder management encompasses a comprehensive communication strategy concerning innovation activities. Thus, my third set of research questions reads as:

Research question 3 (RQ 3): *What communication archetypes can organizations adopt to transmit their innovation activities to shareholders in order to better cope with economic distress?*

> *RQ 3a: What archetypes exist when organizations can choose between innovation communication through words, investments, and results?*
>
> *RQ 3b: Is any communication archetype better suited to convince investors and stakeholders during periods of distress?*

The three research questions and subordinate refinements present a holistic overview of this dissertation's focus. Table 7 summarizes this dissertation's research questions and maps the three studies accordingly.

Table 7: Research questions for studies I to III based on the research gap

How do innovation assets, entrepreneurial actions, and communication strategies drive crisis resilience under firm-specific conditions?		
RQ 1	**How does pre-crisis innovation activity contribute to organizational resilience under consideration of challenging pre-crisis experiences?**	
RQ 1a	Does a strategic emphasis on innovation influence how organizations experience the post-crisis period?	Study I
RQ 1b	Do challenging, pre-crisis profitability conditions alter the influence of innovation on resilience in a beneficial or harmful way?	Study I
RQ 2	**How does an entrepreneurial attitude influence short-term market reactions given differences in the financial structure?**	
RQ 2a	Do organizations with an entrepreneurial orientation show superior or inferior short-term stock market performance at the outbreak of the crisis?	Study II
RQ 2b	Does a higher degree of debt financing alter the influence of entrepreneurial orientation on instant stock-market reactions in a beneficial or harmful way?	Study II
RQ 3	**What communication archetypes can organizations adopt to transmit their innovation activities to shareholders in order to better cope with economic distress?**	
RQ 3a	What archetypes exist when organizations can choose between innovation communication through words, investments, and results?	Study III
RQ 3b	Is any communication archetype better suited to convince investors and stakeholders during periods of distress?	Study III

Source: own illustration

Lastly, research questions, research studies, and the literature framework are in a coherent relationship (Table 8). I see all resilience-building categories [1] to [4] covered by studies I to III with both main (♦) or subordinate (▪) foci. Dependent variables (○) in [5.1] and interactions (~) in [2] and [5.2] complete the picture.

Table 8: Relationship among RQ 1 to 3, studies I to III, and the literature framework

	[1] Environment & situation	[2] Assets & resources	[3] Actions & decisions	[4] Skills & capabilities	[5.1] Org. resilience	[5.2] Firm performance
RQ 1 Study I		♦			○	~
RQ 2 Study II	▪	~	♦		○	
RQ 3 Study III		▪	▪	♦	▪	

Legend: ♦ main focus, ▪ subordinate focus, ○ dependent variable, ~ interaction
Source: own illustration

3 Theoretical foundations

This chapter presents the principal theoretical foundations used to answer the research questions. The focus of this section is an alignment between management theories and this dissertation's research theme, less a controversial discussion of their evolvement and representation in academia. Study I considers the resource-advantage theory and the network theory covered in chapters 3.1 and 3.2. Study II considers the contingency theory and the human capital theory covered in chapters 3.3 and 3.4. The efficient market theory, briefly introduced in chapter 3.5, justifies the stock market-based methodological setup and is essential for all studies I to III.

3.1 Resource-advantage theory

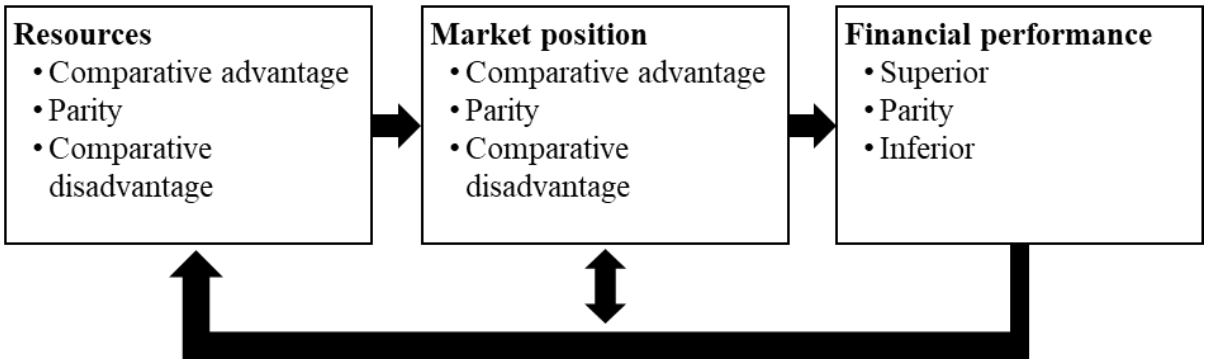
The resource-advantage theory (RAT) proposes that an organization's resources and how it structures, bundles, and leverages its assets are decisive for long-term competitive advantage in the marketplace (Hunt & Morgan, 1995). The resource-advantage theory is also referred to as "the comparative advantage theory of competition" (Hunt & Morgan, 1995) or the "general theory of competition" (Hunt, 2000). Rooted in marketing research, the RAT expanded into domains such as economics, law, and management (Hunt, 2012).

The fundamental concept of the RAT is shown in Figure 14. An ever-present condition of the RAT is the state of disequilibrium in which the players constantly compete for better comparative performance (Hunt & Morgan, 1995). The natural starting point is a firm's initial set of tangible or intangible resources, enabling it to begin production or service delivery (Barney, 1991; Lado & Wilson, 1994). Depending on the firm's geographical location and business model, the starting resources are either readily available and accessible or must be acquired in a more costly process. Then, competition sets in and motivates companies to use their initial assets to gain a comparatively better market position, which may, in turn, lead to superior financial performance (Hunt & Morgan, 1995). Both, achievements in market position and

financial performance results have reinforcing effects on resources. As such, companies that perform comparatively better in any dimension are more likely to succeed in the next iteration.

Hunt and Morgan (1995: 318) further propose that companies that cannot or do not keep up with comparatively superior peers "attempt to neutralize and/or 'leapfrog' the advantaged firm by better managing existing resources and/or by acquisition, imitation, substitution, or major innovation." As such, they find ways to make up their own deficits to re-participate in the next resources-market position-financial performance cycle.

Figure 14: Schematic view of the research-advantage theory



Source: Hunt and Morgan (1995)

The original theory from 1995 has been substantiated and developed further by several researchers to reflect academic review processes and new developments in the domain of management business and research (Griffith & Yalcinkaya, 2010; Hunt, 2012). As such, the typical 'neoclassical resources' of land, labor, and capital have been further specified and completed by, e.g., financial resources (e.g., cash, access to financial markets), legal resources (e.g., trademarks, licenses, patents), human resources (e.g., skills and knowledge of individual employees), organizational resources (e.g., competences, controls, policies, culture), and relational resources (e.g., relationships with suppliers, customers, authorities) (Hunt, 2012).

With regards to the aspiration of this dissertation, I see a good fit between the research theme and the RAT. First, required resources for a successful innovation and entrepreneurial culture are well represented by the theory, in particular, because it considers financial, legal, and organizational resources. Second, the innovation cycle, i.e., ideation, design, commercialization, and improvement (Geissdoerfer, Bocken, & Hultink, 2016), is comparable to and compatible with the iterative process of the RAT. Third, both innovation success and entrepreneurial culture are path-dependent, such that success and achievements or failures and defeats have direct positive or negative consequences on subsequent steps.

3.2 Network theory

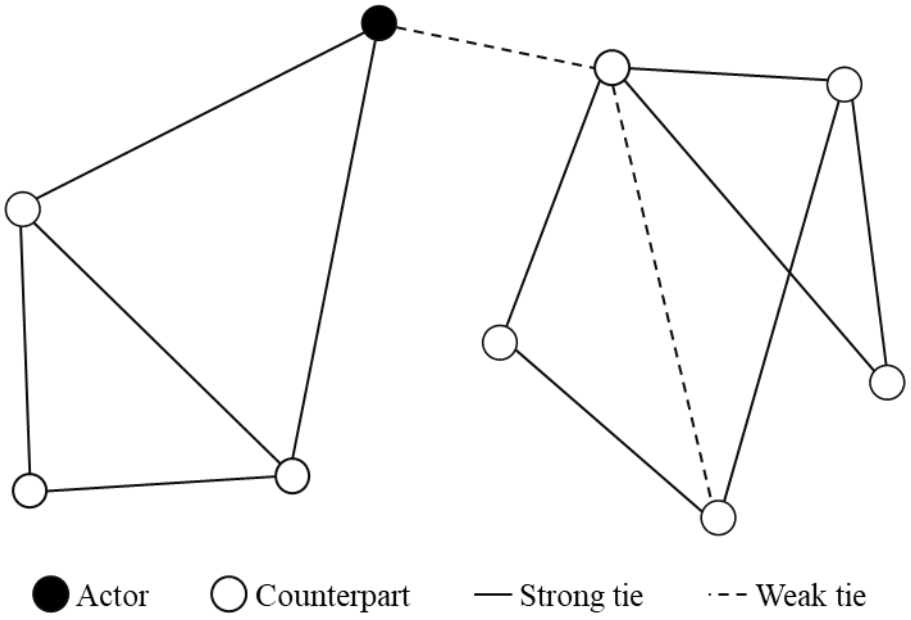
The network theory describes, explains, and predicts relations among a firm's internal and external stakeholders (e.g., Granovetter (1973); Thorelli (1986)). It "involves creation of a blend of strong and weak ties between nodes that match the firm's needs in order to maximize firm performance" (Hult, 2011: 519). Even though network theory originates in the domain of marketing research, it is well applicable to other settings (Borgatti & Halgin, 2011).

In essence, the network theory consists of actors, resource ties, and activities. Actors control resources and perform activities; activities connect different resources to each other. Activities occur when actors combine, create, develop, or exchange different resources with each other; resources are defined as financial assets, knowledge, personnel, physical goods, and technology (Hult, Hurley, & Knight, 2004).

More simply and concretely, network theory addresses the following. An actor has several connections. Some connections are strong (i.e., tight), and others are weak (i.e., loose). While the first intuition may assume that strong relationships are more beneficial than weak ones, the opposite may, depending on the context, also be true. The argumentation reads as follows. In many situations, strong connections cannot contribute anything new or cannot widen an actor's horizon, simply because both actor and strong tie counterpart are located in the same

environment and experience the same situations. For weak ties, both actor and counterpart are embedded in different environments and experience different situations. As such, the weak tie counterpart possesses resources, e.g., knowledge, information, and relationships that the actor does not own. Hence, only through the weak tie, actors can access (some of) the counterpart's resources (Granovetter, 1973).

Figure 15: Network theory with strong and weak ties



Source: own illustration

With regards to the aspiration of this dissertation, I see a good fit between the research theme and the network theory. First, strong and weak ties between individuals, teams, and departments exist with both internal and external stakeholders. This is particularly the case for the topic of innovation, which demands collaboration and cooperation across organizational boundaries. Second, larger and easier access to different physical and non-physical resources is crucial for new product development or process improvement. Network theory explains how such

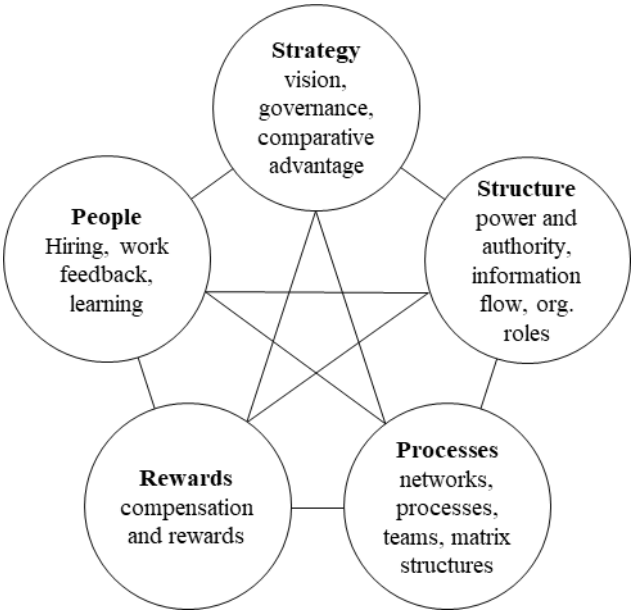
resources can be accessed without actually possessing them. All this becomes even more important as innovation complexity increases.

3.3 Contingency theory

Contingency theory explains that there is not one single, best way to structure an organization and that each way of structuring an organization is not equally effective (Galbraith, 1973). Scott (2005: 89) explains that "organizations whose internal features best match the demands of their environments will achieve the best adaption [...]. The best way to organize depends on the nature of the environment to which the organization relates".

The contingency theory is based on organizational design and assumes that organizations' subunits face different market demands. Rather than centrally addressing the various needs, organizations are advised to create a dedicated organizational structure and introduce processes that fit market requirements (Hult, 2011). A potential organizational split may differentiate between the dimensions of strategy, structure, processes, rewards, and people (Figure 15). A potential process-related split may differentiate between levels of formalization, planning, and time horizon (Hult, 2011). Organizational and process-related complexity must constantly adapt to market conditions to keep up with the overall environmental changes.

Figure 16: Star model of organizational design



Source: Galbraith (1973)

With regards to the aspiration of this dissertation, I see a good fit between the research theme and the contingency theory. The theory suggests that an organizational setup must meet market requirements to achieve the best firm performance – in this case, interpreted and applied as crisis resilience (Scott, 2005). I expect entrepreneurial attitude, pragmatism, flexibility, and decisiveness to drive organizational restructuring so that structures and processes meet market requirements comparably better and faster, especially in challenging times.

3.4 Human capital theory

The human capital theory proposes that human capital characteristics are critical for economic success in entrepreneurial-oriented firms (Unger, Rauch, Frese, & Rosenbusch, 2011). Decisive characteristics include, among others, competencies, education, experience, knowledge, and skills (Clardy, 1996; Florin, 2005; Florin, Lubatkin, & Schulze, 2003). Academia actively debates if, and if yes, which characteristics are more important than others. Today, for many researchers, skills and experience are the most relevant factors for economic success, mainly

because of the constantly increasing knowledge-intensive activities in most work environments" (Unger et al., 2011: 342).

Based on Becker (1964), human capital consists of skills and knowledge that employees acquire through school, training, and experiences. Becker (1964) differentiated between investments and outcomes as well as between impart and develop (Table 9). The feature of 'acquire' was added later (Reuber & Fischer, 1994; Sohn, Doane, & Garrison, 2006). Investments refer to education, training/experiences, and recruitment, potentially leading to knowledge, skills, and abilities (outcomes). Knowledge is defined as "the possession and understanding of principles, facts, processes, and the interactions among them" (Marvel, Davis, & Sproul, 2016: 617). The dimension of knowledge can range from general to highly specific, while the latter tends to be more beneficial to firm success (Markman & Baron, 2003). Skills "refer to observable applications or know-how [and] are not necessarily enduring characteristics and depend on experience and practice" (Marvel et al., 2016: 618). Skills tend to be highly specific to certain tasks and can be developed through training, experience, education, and practice. Abilities "is an underlying or enduring characteristic useful to performing a range of tasks [and] at the individual level [...] often associated with general traits" (Marvel et al., 2016: 618). In difference to knowledge and skills, abilities can be gained by investing in teams, alliances and organizations.

Table 9: Typology of human capital

	Investments	**Outcomes**
Impart	Education – investments in learning activities of explicit knowledge	Knowledge – understanding of principles, facts, and process
Develop	Training/experience – investments in learning by doing activities	Skills – observable application of knowledge to create solutions to problems or complete specific tasks
Acquire	Recruitment – investments in recruitment activities to acquire abilities	Abilities – Enduring, trait-like characteristics useful to a range of tasks

Source: Marvel et al. (2016)

With regards to the aspiration of this dissertation, I see a good fit between the research theme and the human capital theory. First, even though my studies look at the entrepreneurial orientation of the whole firm rather than that of an individual, the management team's knowledge, skills, and abilities play a crucial role in determining the organization's focus. Accordingly, basing the empirical findings on the human capital theory is justifiable. Second, a systemic crisis is an exceptional situation that demands capabilities that textbooks can hardly cover. As such, universally applicable knowledge, skills, and abilities appear more beneficial than formal education and training.

3.5 Efficient market hypothesis

The efficient market hypothesis is only briefly presented as it is not used to substantiate any empirical findings. Instead, it plays a crucial role in the methodological setup as most dependent variables depend on stock prices, for which I assume efficient markets. Fama, Fisher, Jensen, and Roll (1969) propose that markets are efficient, i.e., that a stock price incorporates all relevant information at any point in time. As such, buyers and sellers always trade shares at their fair market value. This further implies that investors can never buy undervalued stocks at lower-than-fair prices or sell overvalued stocks at higher-than-fair prices.

In case new information becomes public, e.g., the outbreak of a (systemic) crisis, the efficient market hypothesis assumes that any stock price reaction is entirely attributable to the new situation. As such, stock price reactions reflect a company's crisis preparedness or resilience. In study I, I observe daily closing prices for up to five years; in study II, I observe daily closing prices for up to 100 days.

4 Research design

This dissertation aims to strengthen the understanding of organizational resilience in light of innovation activities, entrepreneurial behavior, and communication strategies. Besides answering the research questions laid out in chapter 2.3, I contribute highly needed empirical work. As such, I match accounting data, stock price information, innovation indicators, and entrepreneurship scores to run ordinary least squares (OLS) regressions, survival models, abnormal return calculations, and cluster analyses.

Chapter 4.1 explains why the 2008 Great Financial Crisis is selected as the research setting; chapter 4.2 describes the sample development and distinguishes between data sources (4.2.1) and sample preparation (4.2.2). Chapter 4.3 describes the methodological approaches of the three studies in greater detail. The research design is inspired by the renowned work of DesJardine et al. (2019), Sajko et al. (2020), and McWilliams and Siegel (1997).

4.1 Crisis selection

I consider the 2008 Great Financial Crisis (2008 GFC) an ideal setting for evaluation. As presented in chapter 2.1.2, other researchers made the same choice (e.g., Brown and Petersen (2015); Buyl et al. (2019); Laidroo and Sokolova (2015)).

First, up until then, the GFC was unprecedented in its duration and depth as it lasted about 18 months, triggered a 6% U.S. gross domestic product (GDP) decline, and doubled the long-term, historical-high unemployment rate (Kalleberg & Wachter, 2017; Song & Wachter, 2014). Second, even though the GFC originated in the U.S., it eventually impacted economies, governments, corporations, and private households across the globe, irrespective of wealth, size, and industry focus. Third, while in retrospect, several indicators hinted toward a crisis, its actual outbreak and timing were mostly unexpected (Lin & Treichel, 2012). As such, I can reasonably assume that organizations could not initiate dedicated mitigating measures a priori but could

only rely on their general crisis management assets. Lastly, as the GFC officially ended in June 2009, I can adequately apply the models to both the crisis's core and recovery period.

4.2 Sample development

In response to the finding that sample sizes of relevant studies are typically smaller than 1,001 observations (Figure 9), this dissertation's empirical work is purposely based on a large, secondary data set of listed U.S. American companies. Chapter 4.2.1 explains which data sources were used; chapter 4.2.2 describes how the data sets were connected and which adjustments were made to retrieve the final set data set.

4.2.1 Data sources

I used five primary data sources: S&P 1500 (Standard & Poors 1500) for sample construction, Compustat for accounting information, USPTO for patent information, EDGAR for annual reports, and CRSP (Center for Research in security prices) for stock price data. The following paragraphs provide further insights.

S&P 1500. This dissertation's sample is based on all public U.S. corporations listed on the S&P 1500 as of September 16, 2008. The S&P 1500 composite index combines three leading indices for large-, mid-, and small-cap companies, i.e., S&P 500, S&P 400, and S&P 600, and covers approximately 90% of the U.S. market capitalization (S&P Dow Jones Indices LLC, 2020b). Even though all S&P 1500 companies are headquartered in the USA, most companies generate their revenue and profits from worldwide business activities. Hence, the performance of S&P 1500 companies is influenced or driven by the global rather than America-only economy. The reference date, i.e., September 16, 2008, was chosen in line with prior work, which defined September 17, 2008, as the starting date of the GFC (DesJardine et al., 2019; Isidore, 2008). On September 15, Bank of America acquired Merrill Lynch, and Lehman Brothers filed for bankruptcy. On September 16, the Federal Reserve Board supported AIG with an $85 billion loan to prevent a bailout (Amadeo, 2020). On September 17, investors withdrew $144 million

from the U.S. money market, causing the short-term lending market to freeze (Gullapalli & Anand, 2008). This sequence of events substantiates the chosen reference date. Using the S&P 1500 or any of its components, i.e., S&P 500, S&P 400, or S&P 600, is good practice in academic research (e.g., Sajko et al. (2020); Walrave et al. (2017)).

Compustat. I enriched the sample of S&P 1500 companies with accounting information from the Compustat database provided and maintained by Wharton Research Data Services (WRDS). The database contains, among others, information on yearly revenues, costs, profits, assets, and liabilities (WRDS, 2022). While most of this information is used to define control variables, I extracted data on research and development expense data to create one of my main dependent variables, i.e., R&D stock, also referred to as innovation input - quantity in study I. The use of Compustat data is academic standard (e.g., Amore (2015); Brown and Petersen (2015); Srinivasan et al. (2011)).

USPTO. One of many options to determine innovation focus is observing and evaluating patent filings. Since filed patents are public, all patent resources are freely available for download. The database is maintained by the United States Patent and Trademark Office (USPTO) and is considered to be a highly reliable data source for innovation research (Kim & Lee, 2015). Given the vast size of patent information, apart from master and citation data, patents may contain, e.g., extensive descriptions and images, it is available in a modular structure. As such, researchers can combine relevant information according to their specific needs. This dissertation focuses on the measures patent count, interpreted as innovation output - quantity, and forward citations, interpreted as innovation output - quality. The USPTO database has also been used by, e.g., Amore (2015) and Lee et al. (2018) to create innovation-related variables.

EDGAR. One of many options to determine innovation focus and entrepreneurial orientation is evaluating annual reports, more specifically the management discussion and analysis (MD&A) sections. Listed companies are obliged to submit their financial statements, including qualitative management information, in a standardized format to the U.S. Securities and

Exchange Commission (SEC). I retrieved annual reports for the years 2003 to 2008 from the EDGAR database via an application programming interface (API). Annual reports' MD&A section "is a narrative explanation of the financial statements and other statistical data that the registrant believes will enhance a readers' understanding of its financial condition, changes in financial condition and results of operation." (SEC, 2008). Even though management must provide a fair and honest view, it can set focal points, stress specific developments, and omit less relevant ones. Through a dictionary-based textual analysis of annual reports' MD&A sections, I derive both an aggregate measure of entrepreneurial orientation as well as five sub-measures that constitute different dimensions of EO, i.e., autonomy, innovativeness, proactiveness, competitive aggressiveness, and risk-taking (Lumpkin & Dess, 1996).

CRSP. Most of this dissertation's statistical calculations depend on stock price developments. Therefore, I retrieved daily stock price information from the Center for Research in Security Prices (CRSP), which is affiliated with the University of Chicago Booth School of Business. Apart from opening and closing prices, dividend payments, and trading volumes, the CRSP database contains computed values for different sorts of returns, e.g., annualized return, cumulative return, and delisting return (CRSP, 2022). Data from the CRSP database helped construct independent variables for stock price drop, time to recovery, and cumulative abnormal returns. Among others, DesJardine et al. (2019) and Sajko et al. (2020) accessed the CRSP database for their studies.

4.2.2 Sample preparation

I constructed the data set for my statistical analyses in six steps, according to the order shown in Figure 17. While this section contains an overview of sample preparation, further details, especially regarding variable construction, are described in the methodology sections of each research study.

First, I retrieved the list of S&P 1500 companies as of September 16, 2008, checked the data for integrity, and obtained 1,497 results. The difference of three results from an asynchronous timing of drop-outs and additions. While drop-outs are recorded immediately, additions are carried out only once per month (S&P Dow Jones Indices LLC, 2020a). The S&P 1500 data set contains the Global Company Key (GVKEY) as the unique identifier for data aggregation.

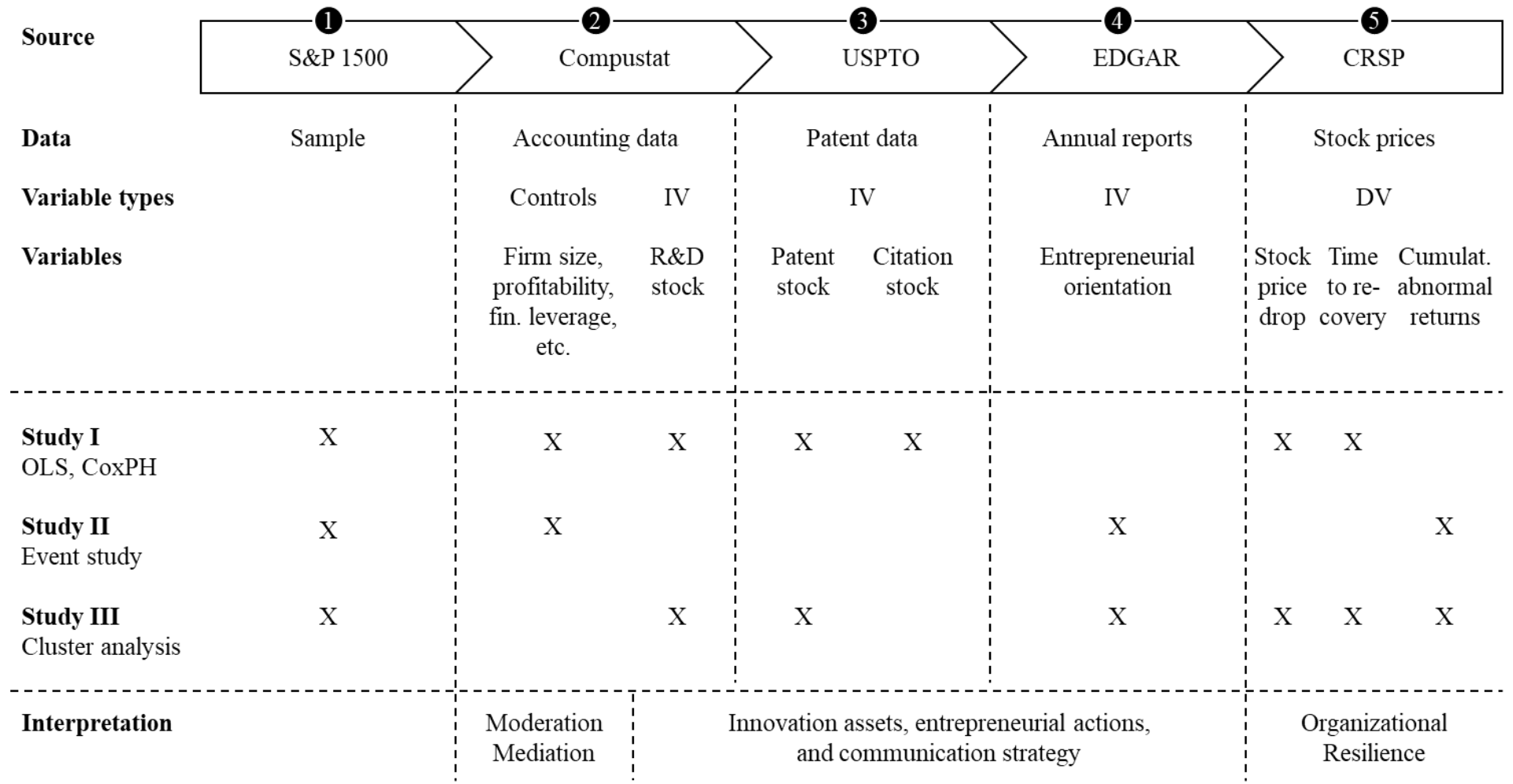
Second, I matched the Compustat database to retrieve all required figures to construct control variables and the independent variable research and development stock (R&D stock), which is, in essence, a time-weighted aggregation of yearly expense data. I used the GVKEY as the common unique identifier and did not recognize any data mismatches. I limited the import for Compustat data to the years 1990 to 2015. The variable containing research and development expense data shows a significant amount of missing values (i.e., for 61% of companies, R&D expense data is unavailable). Therefore, I investigated the possibility of a sample selection bias but am confident to reject any concerns.

Third, I retrieved the USPTO patent data from PatentsView.org and focused on packages containing master, application, and citation data. These packages can be matched internally by patent ID; matching with other data sets is more complex and requires a cautious approach. To ensure a high-quality mapping, I progressed in three steps: (1) I linked the combined S&P 1500-Compustat data with a publicly available crosswalk created and maintained by Kogan, Papanikolaou, Seru, and Stoffman (2017). (2) I verified 10% of the matches manually. (3) I ran statistical tests to identify differences in means. None of the steps led to significant concerns. I replicated the approach of R&D stock computation to construct the independent variables patent stock and citation stock. More details on the exact matching and variable construction process can be found in the methodology chapter of research study I.

Fourth, I retrieved all annual reports for the years 2003 to 2008 from the EDGAR database with the help of an R tool created and maintained by Lonare, Patil, and Raut (2021). Mass download and data matching can be pursued using the GVKEY as a unique identifier. The

independent variable entrepreneurial orientation and its five subdimensions have been created with the help of a dictionary-based textual analysis proposed by Lumpkin and Dess (1996). More details are explained in the methodology chapter of research study II.

Figure 17: Sample preparation and methodological approach



Notes: IV = Independent variable(s), DV = Dependent variable(s), X = included; *Source:* own illustration

Fifth and last, I retrieved daily stock price data from the CRSP database for the years 2008 to 2013. I matched the daily stock price information to my existing data through a combination of GVKEY, PERMCO (permanent issue identifier), and PERMNO (permanent company identifier) identifiers. Given that a crosswalk between these three identifiers leads to m:n relationships, I performed careful checks to ensure correctness. For 1,343 firms, I was able to find exactly one security per company; for the remainder, 154 companies, I identified up to four simultaneously listed stocks. Rather than consciously selecting one specific share, I created trading volume-weighted stock prices and returns and compared the main characteristics of the stock price-based variables with those of DesJardine et al. (2019) and Sajko et al. (2020). I did not notice any differences. I used CRSP data to create my three main dependent variables: (1) stock price drop, also referred to as severity of loss, is the absolute percentage loss in the stock price in the 12 months following the start of the 2008 GFC; (2) time to recovery, is the number of days until a stock price reached its pre-GFC level; (3) cumulative abnormal return, is the sum of all daily abnormal returns for a defined event window. More details can be found in the methodology chapters of research studies I and II.

Before running the statistical analyses, I pursued a final check for data integrity. As a result of these checks, I dropped seven firms due to unresolvable data inconsistencies between company fundamentals and stock price information. Accordingly, my grand sample consists of 1,490 out of 1,500 maximum possible firms (99.3%). However, the actual number of observations entering my models varies according to the number and type of data-restricted variables. Data restrictions principally refer to missing values for R&D stock (909 missings), patent stock (756), citation stock (770), entrepreneurial orientation (529). This is unproblematic as long as overall model parameters, e.g., the f-statistic, remain statistically significant.

4.3 Methodological approach

To verify this dissertation's hypotheses and answer the three main research questions, I develop four statistical approaches to ensure a fit between research questions, data structure, and variable characteristics: OLS regression (study I), Cox proportional hazard model (also known as (a.k.a) survival analysis, study I), event study (study II), and cluster analysis (study III). This chapter provides an overview of all four approaches, while model details and parameters are explained in the respective methodology sections of studies I to III. The match between study, statistical approach, and variable consideration is reflected in Figure 17. The output of the sample development process described in chapter 4.2 and shown in Figure 17 is a cross-sectional data set. It contains 1,490 observations, i.e., one for each company.

The stock price development is central to most of this dissertation's statistical analyses. As such, Figure 18 provides an indexed stock price chart for all sample companies between January 2008 and July 2011. The 100% level was set to September 16, 2008, i.e., the day before the crisis outbreak. The sharp decline following the crisis outbreak on September 17, 2008, and the long recovery period lasting until quarter three of 2010 indicate the crisis's severity.

Figure 18: Indexed stock price development for sample companies

Source: own illustration

Study I follows the methodological approach of DesJardine et al. (2019) and Sajko et al. (2020). Organizational resilience is defined by the variables of stock price drop, i.e., the percentage drop of a stock price following the financial crisis, and time to recovery, i.e., the time it takes for a stock to reach its pre-crisis level. The stock price drop measure is analyzed with an OLS regression and enriched by instrumental analysis and interaction effects. The time to recovery variable is explored through a Cox proportional hazard survival model (Bradburn, Clark, Love, & Altman, 2003; Cox, 1972). An essential strength of the Cox proportional hazard model is that it can simultaneously assess the effects of several risk factors on survival time (STHDA, 2022).

Study II is based on an event study. Event studies estimate the effect of unanticipated events on share prices by calculating the abnormal, i.e., non-expected, returns (McWilliams &

Siegel, 1997). These abnormal returns can be either positive or negative, depending on how a specific stock price performs compared to the overall market. To perform the event study, I progressed in two steps. I first calculated the cumulative abnormal returns and, second, inputted the results in an OLS regression.

Study III follows an exploratory approach and employs a cluster analysis. Cluster analyses group observations with similar characteristics based on a set of typically three to five variables such that distances between individual data points are minimized (Hahmann, Volk, Rosenthal, Habich, & Lehner, 2009; Witten, Frank, & Hall, 2011). Cluster analyses are very flexible and results highly depend on model parameters, e.g., the type of distance calculation and the choice of analysis method. The number of clustering groups is critical for statistical results and subsequent interpretation. While hierarchical cluster analyses determine this number by their algorithms, non-hierarchical cluster analyses require the number of groups as an input (Blashfield & Aldenderfer, 1978). Besides statistical approaches to identify a reasonable number of clusters (Charrad, Ghazzali, Boiteau, & Niknafs, 2014), I visually inspected the K-means knee plot to derive an answer.

Extensive robustness checks, such as using heteroscedasticity-consistent standard errors, and confirming the results by running the models on smaller subsamples, with different time frames, or on alternative covariates, are part of each study. Model-specific robustness checks are discussed separately in each study and include, among others, an inspection of residuals as well as checks for constant error variance, multicollinearity, and endogeneity.

I performed all statistical analyses in R, a free software environment for statistical computing and graphics (The R Foundation, 2022). The textual analysis has been conducted with LIWC2015 software.

5 Summary of research studies

This chapter contains summaries of my dissertation's core element: three independent, standalone academic research studies that answer the research questions and fill gaps in the literature. The full-length studies, including all tables, figures, and references, are annexed to this introductory overview in Part B.

To acknowledge the valuable contributions of my supervisor Prof. Dr. Andreas Engelen for studies I to III and the beneficial input from Dr. Anna Gründler for research study II, I switch from first person singular (I/my) to the first person plural (we/our). This change mimics the narrative perspective of the full-length studies.

5.1 Summary of research study I

The first study is titled "Shock absorber: cushion systemic shocks and build a resilient organization through pre-crisis innovation." Both the pure number of and temporal proximity between recent crises, e.g., COVID-19 (2020), Great Financial Crisis (2008), 9/11 attacks (2001), indicate that the statistical likelihood of chief officers experiencing at least one crisis in their professional career is high. While current literature on organizational resilience extensively discusses the impact of, e.g., strong supply chain management (Craighead, Blackhurst, Rungtusanatham, & Handfield, 2007), smart business models (Gittell et al., 2006) or generous CSR investments (DesJardine et al., 2019), we found the influence of innovation only sparsely covered (Linnenluecke, 2017). After reviewing relevant literature, e.g., Achibugi (1992) and Devece, Peris-Ortiz, and Rueda-Armengot (2016), we see that academic guidance on managing innovation to master economic challenges is reactionary, i.e., in-crisis focused, rather than pro-active, i.e., pre-crisis focused.

In anticipation of a positive relationship between pre-crisis innovation and organizational resilience, we assume that benefits arise through an economic and procedural component. We expect the former to drive firm value through competitive advantages, e.g., by developing

customer-centric products. At the same time, the latter helps to build skills and establish relationships that employees can utilize to better cope with crisis-related tasks and constraints (Ortiz-de-Mandojana & Bansal, 2016).

We base our assumptions on two theories. First, we see a fit with the resource-advantage theory by Hunt and Morgan (1995), which proposes that an organization's resources and the way it structures, bundles, and leverages its assets are decisive for long-term competitive advantage in the marketplace. Second, we see a match with the network theory by Granovetter (1973), which describes, explains, and predicts relations among a firm's internal and external stakeholders. To shed further light on the innovation-resilience relationship, we embed our investigations into a contingency perspective and argue that a firm's pre-crisis economic performance plays an important role. We refer to the pre-crisis performance as sense of urgency. As such, we elaborate on the following research question:

Research question 1 (RQ 1)*: How does pre-crisis innovation activity contribute to organizational resilience under consideration of challenging pre-crisis experiences?*

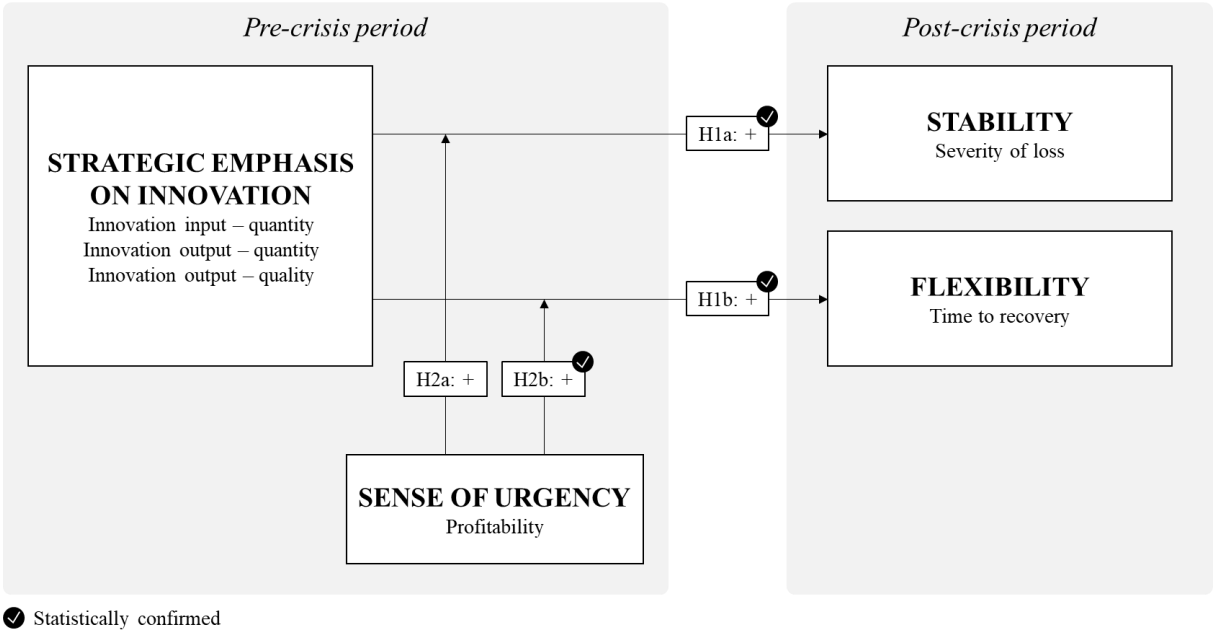
RQ 1a: Does a strategic emphasis on innovation influence how organizations experience the post-crisis period?

RQ 1b: Do challenging, pre-crisis profitability conditions alter the influence of innovation on resilience in a beneficial or harmful way?

We investigate these research questions through a statistical analysis outlined in Figure 19 and draw specific attention to the scope and variety of independent and dependent variables. We measure organizational resilience according to DesJardine et al. (2019) and Sajko et al. (2020) and differentiate between stability (stock price drop / severity of loss) and flexibility (time to recovery). We constitute the strategic emphasis on innovation through R&D stock (innovation input - quantity), patent stock (innovation output - quantity), and citation stock

(innovation output - quality). The moderation with sense of urgency is operationalized through pre-crisis profitability. The grand sample for our statistical analysis consists of 1,490 companies that were part of the S&P 1500 index as of September 16, 2008.

Figure 19: Study I research model



Source: own illustration

Our empirical results show that a strategic emphasis on innovation positively affects organizational resilience in the post-crisis period. More specifically, the positive relationship manifests in both stability (H1a) and flexibility (H1b). Results for the interaction with sense of urgency are more differentiated. We can only confirm a moderating relationship for flexibility (H2b), not for stability (H2a). Firms with a higher sense of urgency, i.e., lower pre-crisis profitability, can better use their innovation resources than those not in an urgency mode. We interpret this insight as a "crisis in a crisis," i.e., firms that experienced difficulties before the main crisis set in were already in a crisis management mode and could therefore react with higher speed and greater precision.

Our study makes both theoretical and practical contributions. First, we enrich the research stream that describes the comprehensive relationship between innovation and firm performance (Rust, Ambler, Carpenter, Kumar, & Srivastava, 2004; Srinivasan et al., 2011; Tellis, 2004). Second, we expand the research on antecedents of organizational resilience (Kronberger, Meyer, Frey-Heger, Gatzweiler, & Marti, 2021). Third, we advise leadership teams to consider innovation as a booster for organizational resilience. Fourth and last, we remind management teams of well-performing companies to strive for constant renewal and optimization of their (innovation) strategy.

5.2 Summary of research study II

The second study is titled "Equalizing tank: employ, balance, and amplify entrepreneurial orientation to develop crisis resilience." While prior research on entrepreneurial orientation (EO) stresses the overall positive effects on company performance (e.g., Soares and Perin (2019); Rauch et al. (2009); Wiklund and Shepherd (2003)), the relationship to crisis resilience has been largely overlooked. Nevertheless, the literature allows for an ambiguous perspective and provides arguments that speak in favor of a positive and negative connection between entrepreneurial orientation and crisis resilience. Arguments in favor of a positive relationship include that a high degree of EO allows for opening up new opportunities (Lumpkin & Dess, 1996), reacting more flexibly (Han & Zhang, 2021), and embodying an attractive public image (Monsen & Wayne Boss, 2009). In contrast, arguments in favor of a negative relationship include that a high degree of EO implies inordinate autonomy (Kubicek, Paškvan, & Bunner, 2017; Langfred, 2004), a lavish investment strategy (Bracker & Ramaya, 2011; Srinivasan et al., 2011), and irrational proactivity (Cangiano, Parker, & Ouyang, 2021; Wihler & Jachimowicz, 2016).

We base our assumptions on two theories. First, we see a fit with the contingency theory by Galbraith (1973), which explains that there is not one single, best way to structure an

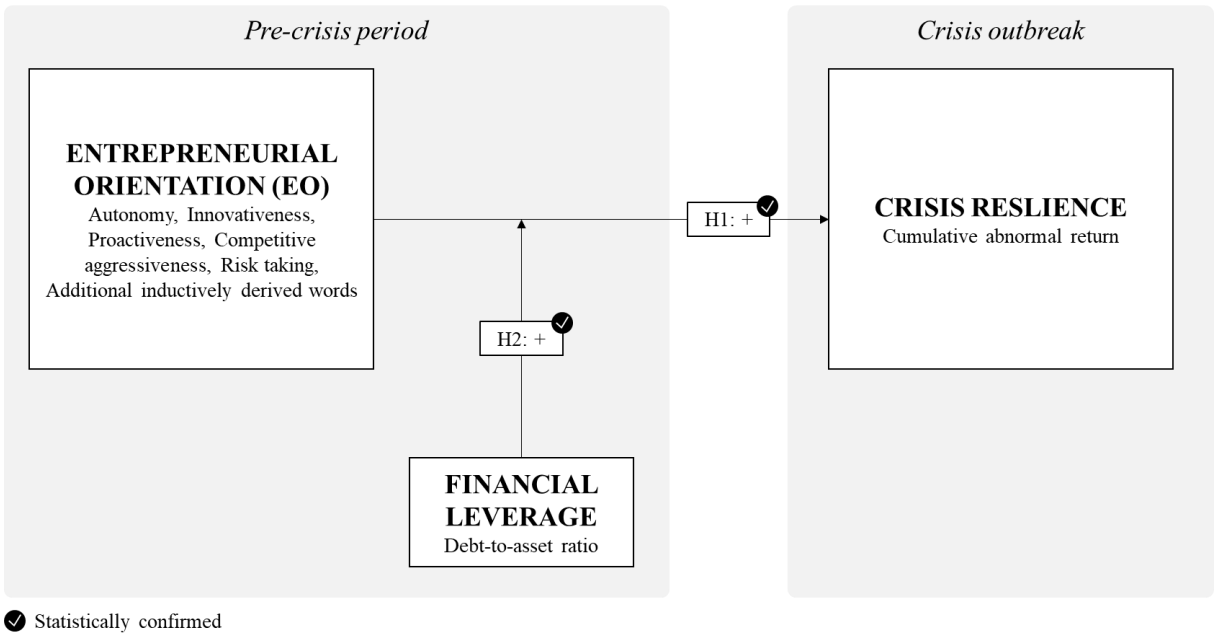
organization and that each way of structuring an organization is not equally effective. Second, we see a match with the human capital theory by Becker (1964), which proposes that human capital characteristics are critical for economic success in entrepreneurial-oriented firms (Unger et al., 2011). To better understand if any of the two positions is dominant and if contingent effects influence the EO-resilience relationship, we elaborate on the following research questions:

Research question 2 (RQ 2): *How does an entrepreneurial attitude influence short-term market reactions given differences in the financial structure?*

> *RQ 2a: Do organizations with an entrepreneurial orientation show superior or inferior short-term stock market performance at the outbreak of the crisis?*
>
> *RQ 2b: Does a higher degree of debt financing alter the influence of entrepreneurial orientation on instant stock-market reactions in a beneficial or harmful way?*

We investigate these research questions through a statistical analysis outlined in Figure 20. We measure crisis resilience through an event study and utilize a variety of event window lengths and model parameters to corroborate our findings (Kliger & Gurevich, 2014; MacKinlay, 1997; McWilliams & Siegel, 1997). We follow Short, Broberg, Cogliser, and Brigham (2010) to retrieve a score for entrepreneurial orientation, including its five subscores from companies' annual reports' MD&A sections. The moderation with financial leverage is operationalized through the debt-to-asset ratio. The grand sample for our statistical analysis consists of 1,490 companies that were part of the S&P 1500 index as of September 16, 2008.

Figure 20: Study II research model



Source: own illustration

Our empirical results show that entrepreneurial orientation positively influences crisis resilience in the post-crisis period (H1). The same holds for the moderation with financial leverage (H2). We interpret the interaction result by arguing that financial leverage takes on a corrective role. For firms with an under-average EO, financial leverage can naturally not exert this compensating role since there are no – or only minor – negative EO characteristics to offset. For Firms with an average or even over-average level of EO, negative characteristics become observable, e.g., inordinate autonomy (e.g., Kubicek et al. (2017)), a lavish investment strategy (e.g., Bracker and Ramaya (2011)), and irrational proactivity (e.g., Cangiano et al. (2021)). Higher levels of debt financing mitigate and reduce EO's unfavorable characteristics, such that crisis resilience is partly restored. Reasons for debt financing's positive influence relate to introducing banks as additional stakeholders who contribute third-party opinions (Sandbu, 2012), reviewing investment decisions more critically and based on objective criteria (Beladi, Deng,

& Hu, 2021; Ferrando et al., 2017), and planning ahead and forcing organizations to show discipline (Moghadam & Jafari, 2015).

Our study makes both theoretical and practical contributions. First, our study is a pioneer in linking EO to a crisis. Second, we introduce financial leverage as a new moderator (Rauch et al., 2009). Third, we raise CxO's awareness that the generally desirable characteristics of EO can turn into negative ones if an EO-building strategy is too ambitious (Hoffmann, Lavie, Reuer, & Shipilov, 2018; Langfred, 2004). Fourth, we raise CxO's awareness that balancing influences can add value – not only but also in times of distress (Andersen & Jaeger, 1999).

5.3 Summary of research study III

The third study is titled "Manual transmission: convince stakeholders of innovation activities through words, investments, and results." The value of innovation has been abundantly discussed in the literature, and the majority of contributions attribute positive characteristics and effects to innovation activities (e.g., Bigliardi, Ferraro, Filippelli, and Galati (2020); Mendoza-Silva (2021)). Central to this study is the expectation that each company is somehow innovative in its own respects.

By referring to Purcell (2019), we briefly answer the question of why innovation is important for business success. First, innovation helps companies grow by generating additional revenues from new products and services or by adapting the business model (Mikhalkina & Cabantous, 2015; Trapp, Voigt, & Brem, 2018). Second, innovation keeps organizations relevant as they must constantly adapt to new realities such as megatrends, climate change, and digitization (Beinhocker, Davis, & Mendoca, 2009; Krys & Born, 2020). Third, innovation helps organizations differentiate by doing things differently and finding new ways of defending their market position (Mifli, Hashim, & Zainal, 2017; Ooi & Husted, 2021).

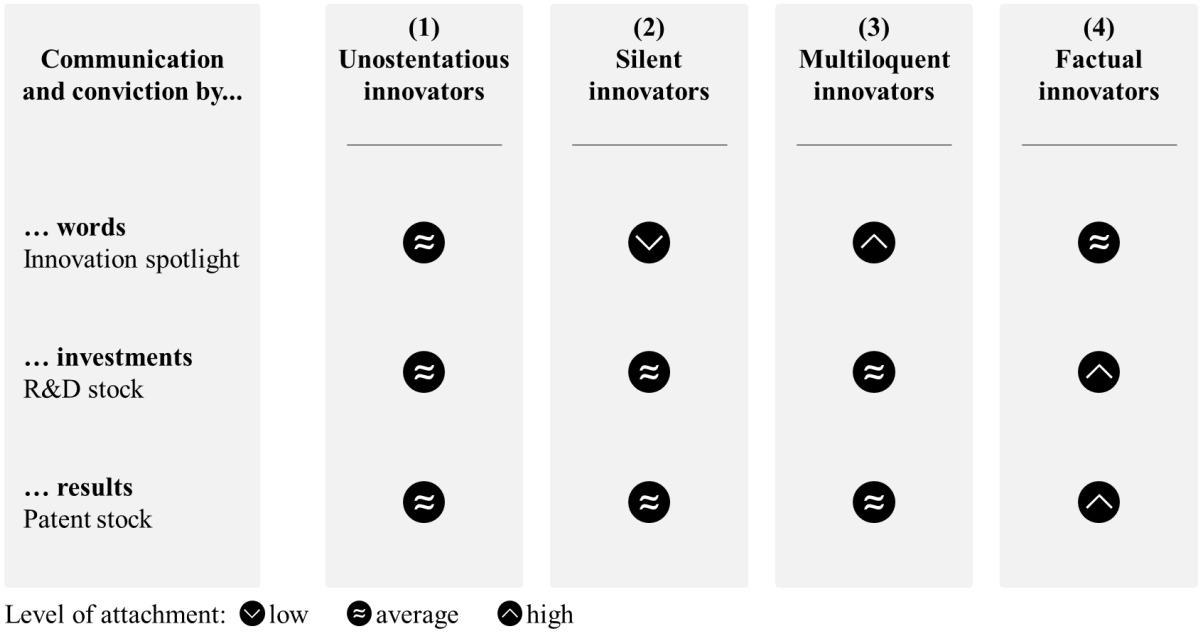
However, the above characteristics do not unfold automatically but are dependent on stakeholder actions, e.g., those of customers, employees, and investors. Overall, a positive perception of the organization appears to be beneficial (Goryachev, 2018). According to Nieminen (2021), companies can trigger and steer these recognition and appreciation processes through a thorough communication and conviction strategy. As such, innovative organizations should actively tell and explain how their innovation activities transform into stakeholder benefits. Hence we conclude that innovation communication is as important as innovation creation (Ackermann, 2013). Thus, we elaborate on the following research question:

Research question 3 (RQ 3): *What communication archetypes can organizations adopt to transmit their innovation activities to shareholders in order to better cope with economic distress?*

> *RQ 3a: What archetypes exist when organizations can choose between innovation communication through words, investments, and results?*
>
> *RQ 3b: Is any communication archetype better suited to convince investors and stakeholders during periods of distress?*

Due to the exploratory approach of this study, we did not formulate hypotheses or refer to management theories. Instead, we ran a cluster analysis to determine how companies communicate their innovation activities to the public. The approach and results are presented in Figure 21. We interpret the variables innovation spotlight, one of EO's five subdimensions, R&D stock, and patent stock as communication and conviction by words, investments, and results, respectively. Statistical tests (Charrad et al., 2014) and a visual inspection of a K-means knee plot suggest constructing four clusters.

Figure 21: Study III research approach and results



Source: own illustration

Our empirical results reveal that each of the four clusters has a different profile regarding communication focus. We differentiate between a low, average, and high attachment. Based on the attachment profile, we introduce a meaningful description, i.e., unostentatious, silent, multiloquent, and factual innovators. Per se, none of the four archetypes is superior or inferior. However, we retrieve a ranking when cross-tabularizing the four archetypes with our crisis resilience variables, i.e., stock price drop, time to recovery, and abnormal returns.

The cross-tabulation reveals that silent innovators are worst-in-class in all three dimensions. Multiloquent and factual innovators are most successful and receive a best-in-class rating for two of the three resilience variables. Unostentatious innovators are middle-of-the-road and, as such, inconspicuous.

Our study makes three predominantly practical contributions. First, organizations need to understand that communicating innovation efforts is as vital as pursuing the innovation itself. Second, organizations need to decide how to transmit their innovation efforts – the

communication strategy should not be left to chance. Third, organizations need to mind the implications from a receiver's perspective as characteristics of the different communication strategies are fundamentally unique.

6 Discussion

This chapter closes my dissertation by summarizing the findings on the research questions (chapter 6.1), presenting theoretical contributions (chapter 6.2), discussing practical implications (chapter 6.3), acknowledging limitations and providing avenues for future research (chapter 6.4), and finally concluding this work (chapter 6.5).

6.1 Summary of findings on the research questions

The goal of this dissertation was to answer the overarching research question: How do innovation assets, entrepreneurial actions, and communication strategies drive crisis resilience under firm-specific conditions? Table 10 provides an overview of subordinate research questions, the hypotheses for studies I and II, including results, as well as a brief qualitative summary of the findings of my exploratory research in study III. I could confirm most of my hypotheses; statistical significances are high, i.e., $p \leq 0.01$.

Study I shows that pre-crisis innovation comprehensively supports organizational resilience by making an organization both more stable (H1a) and flexible (H1b). Hypotheses' confirmation is based on robust statistical effects of the innovation input - quantity measure, i.e., R&D stock. Companies that sustainably build an innovation base profit from economic and procedural gains when entering and mastering a systemic crisis. Effects on organizational flexibility are even stronger when firms perceive a sense of urgency in the pre-crisis period (H2b). Sense of urgency, operationalized through pre-crisis profitability, increases organizations' attention and urges them to take corrective, crisis-mitigating actions even before the actual, systemic crisis sets in. In contrast, companies that thrive in the pre-crisis period are caught unprepared and hence are less able to turn innovation assets into crisis mitigating value.

Study II confirms that a distinct entrepreneurial attitude elicits short-term market gains around the outbreak of a crisis (H1). The benefits of an entrepreneurial orientation, e.g., opportunity recognition, flexibility, and stakeholder management, unfold during times of stable

business and during periods of economic distress when business models require adaption, the short- and mid-term future is unpredictable, and supply chains are broken. However, an overly ambitious level of entrepreneurial orientation may carry adverse effects, such as inordinate autonomy, a lavish investment strategy, and irrational proactivity. A higher degree of financial leverage, which triggers third-party advice, a more objective investment appraisal, and additional planning, has a counter-balancing effect (H2). As such, an organization's financial structure does not only have a direct impact on firm performance but can also exert indirect effects on management behavior.

Study III identifies four archetypes that describe how organizations communicate their innovation activities. Firms can generally choose between communication through words, investments, and results. The four archetypes are described as unostentatious innovators, silent innovators, multiloquent innovators, and factual innovators. Each archetype has a distinct communication profile. During times of distress, the silent innovators show inferior crisis resilience, while the multiloquent and factual innovators thrive. As such, innovation communication is as important as the innovation activity itself.

To conclude and answer the overarching research question, I can state that innovation activities, entrepreneurial attitude, and innovation communication support organizational resilience during times of economic distress. The positive effects that innovation and entrepreneurship hold during times of stable business can be transferred to challenging times, even though underlying mechanics differ. Nevertheless, the degree to which innovation assets and entrepreneurial actions contribute to mastering crises depends on firm-specific characteristics, such as the pre-crisis business performance or the financial structure.

Table 10: Research questions and hypotheses for studies I to III including results

How do innovation assets, entrepreneurial actions, and communication strategies drive crisis resilience under firm-specific conditions?		
RQ 1, 1a, 1b Study I	**How does pre-crisis innovation activity contribute to organizational resilience under consideration of challenging pre-crisis experiences?** – Does a strategic emphasis on innovation influence how organizations experience the post-crisis period? – Do challenging, pre-crisis profitability conditions alter the influence of innovation on resilience in a beneficial or harmful way?	
H1a	Pre-crisis innovation positively affects organizational stability once a systemic shock sets in.	Confirmed, $p \leq 0.01$
H1b	Pre-crisis innovation positively affects organizational flexibility once a systemic shock sets in.	Confirmed, $p \leq 0.01$
H2a	Associations between pre-crisis innovation and organizational stability are stronger when pre-crisis firm-level profitability is low.	Not confirmed, $p > 0.05$
H2b	Associations between pre-crisis innovation and organizational flexibility are stronger when pre-crisis firm-level profit-ability is low.	Confirmed, $p \leq 0.001$
RQ 2, 2a, 2b Study II	**How does an entrepreneurial attitude influence short-term market reactions given differences in the financial structure?** – Do organizations with an entrepreneurial orientation show superior or inferior short-term stock market performance at the outbreak of the crisis? – Does a higher degree of debt financing alter the influence of entrepreneurial orientation on instant stock-market reactions in a beneficial or harmful way?	
H1	Firms with a higher EO are more resilient in times of a systemic crisis.	Confirmed, $p \leq 0.001$
H2	Financial leverage has a moderating role such that firms with high levels of EO are even more resilient in times of a systemic crisis.	Confirmed, $p \leq 0.001$

RQ 3, 3a, 3b Study III	**What communication archetypes can organizations adopt to transmit their innovation activities to shareholders in order to better cope with economic distress?** – What archetypes exist when organizations can choose between in-novation communication through words, investments, and results? – Is any communication archetype better suited to convince investors and stakeholders during periods of distress?
Exploratory results	Archetypes: unostentatious innovators, silent innovators, multiloquent innovators, factual innovators Best crisis response: multiloquent innovators and factual innovators; worst crisis response: silent innovators

Abbreviations: H = Hypothesis, RQ = Research questions
Source: own illustration

6.2 Academic and theoretical contributions

This dissertation makes important academic and theoretical contributions, on the one hand, by answering requests for research by fellow authors (Hillmann & Guenther, 2021; Linnenluecke, 2017); on the other hand, by filling untapped research gaps (chapter 2.3). I structure this chapter in three parts and present contributions to the topic of organizational resilience, as well as to the resource-advantage and contingency theory.

Organizational resilience. This work enriches the research stream of organizational resilience in four ways. First, study I contributes to the academic literature by introducing pre-crisis innovation as a relevant factor for organizational resilience. To date, authors have focused on observing and analyzing a firm's innovation activities during the crisis's recovery period (e.g., Archibugi, Filippetti, and Frenz (2013); Brown and Petersen (2015); Paunov (2012)). Since study I shows that a strategic emphasis on pre-crisis innovation softens the negative consequences of a systemic shock, it assigns pre-crisis innovation an insurance-like character. As such, this dissertation demonstrates that a thorough innovation strategy does not only unfold benefits in times of stable business but also during times of distress.

Second, study II introduces entrepreneurial orientation as an antecedent of organizational resilience. So far, the concept of EO has been applied to various contexts – typically concerning (financial) performance. In contrast, the link to crisis resilience has not yet received particular attention (Rauch et al., 2009). Instead of simply inferring the positive attributes from the established EO-performance link to the topic of organizational resilience, study II empirically tests the direct relationship between the two. Thereby, study II underlines the positive implications of EO but also stresses potential adverse effects. The research on additional antecedents of organizational resilience responds to avenues for future research proposed by, e.g., Hillmann and Guenther (2021) and Rauch et al. (2009).

Third, studies I and II disaggregate the overall positive effect of pre-crisis innovation and entrepreneurial orientation by introducing contingency factors. Thereby, both extent existing literature on organizational resilience in two ways. First, innovation is even more beneficial when a firm's pre-crisis profitability was low, and second, entrepreneurial orientation is even more powerful when companies were financially leveraged. In the first case, lower profitability leads to a higher sense of urgency, which triggers companies to initiate crisis-mitigating initiatives earlier (study I). In the second case, a higher degree of financial leverage counterbalances the harmful effects of an overly ambitious entrepreneurial orientation (study II). As such, my research proposes to regard organizational resilience always in light of firm-specific characteristics.

Fourth and last, studies II and III contribute to the academic literature by employing an alternative method to measure and evaluate organizational resilience. Study I operationalized the resilience measure through the components of stability and flexibility, thereby covering the mid- to long-term focus (DesJardine et al., 2019; Sajko et al., 2020). Study II, in contrast, is based on an event study with an extreme short-term focus of 10 days. Study III evaluates the measures for crisis resilience through a cluster analysis that compares different archetypes of innovation communication. To my knowledge, reputable research has not yet published empirical work on the innovation-resilience relationship based on an event study or cluster analysis methodology. Accordingly, this research takes a pioneer position and enlarges the set of potential methods to measure organizational resilience. It responds to a call for research from Linnenluecke (2017).

Resource-advantage theory. This dissertation extends the resource-advantage theory by Hunt and Morgan (1995) in two ways. First, by focusing on innovation activities and entrepreneurial orientation, studies I and II address the theory's dimension of *resources* (Figure 14). While Hunt (2012) broadened the neoclassical resources of land, labor, and capital to financial, legal, human, organizational, and relational resources, the factors of innovation and

entrepreneurship have a cross-sectional character. They do not necessarily address one resource type exclusively. In fact, both innovation strategy and entrepreneurial orientation have touch-points to practically every function and department so that only an organization-wide aspiration to innovativeness and entrepreneurship can yield the expected benefits.

Second, studies I and II extend the theory's dimension of financial performance by interpreting financial performance as crisis resilience. In their schematic view, Hunt and Morgan (1995) present financial performance as the last, consequential element in the sequence of resources, market position, and financial performance (Figure 14). Even though financial performance and crisis resilience are similar in their operationalization, the underlying concept is fundamentally different and hence an alteration of and new component to the original theory. Moreover, the contingency factors identified in studies I and II, i.e., pre-crisis profitability and pre-crisis financial leverage, suggest that there is also a direct connection between *resources* and *financial performance*, that does specifically not function through the element of *market position*. In sum, while the resource-advantage theory is well suited to explain the relationship revealed in studies I to III, this dissertation's findings also expand the original theory of Hunt and Morgan (1995).

Contingency theory. Studies I to III sharpen the contingency theory in two ways. First, the empirical results of studies I and II show that the benefits of a coherent organizational setup are not limited to firm performance during the typical business cycle periods but also apply in times of a deep, systemic shock (e.g., 2008 GFC). As Galbraith (1973) did not specifically focus on adverse macroeconomic events of such magnitude, this research extends the original theory. Second, study III adds an overarching communication element to the topic of organizational design. While Galbraith (1973) and Scott (2005) focus on the core setup, i.e., strategy, structure, processes, rewards, and people, study III suggests that the communication of effort and achievements is equally important. Similar to the contingency theory, which says that there is no single best way to structure an organization, there is no single best way to innovation communication.

To conclude this subchapter, two points stand out. First, this research makes considerable contributions to the literature stream of organizational resilience through additional antecedents and contingencies. Second, this dissertation enriches established management theories by contributing additional perspectives to the theories' core propositions.

6.3 Practical and managerial contributions

My research provides a set of practical and managerial contributions. Just by considering the latest prominent crises with a lasting global reach, i.e., the 2022 Russian attacks on the Ukraine and COVID-19, the likelihood of management teams and CxOs experiencing at least one significant crisis during their professional career appears to be extraordinarily high. Fortunately, my research suggests that organizations in general and leadership teams in specific are not at the mercy of a systemic crisis but can actively soften crisis-related losses. As such, studies I to III put forward five relevant practical and managerial contributions that guide management teams and CxOs in preparing their organization for the next systemic shock.

First, in difference to prior research, which provides managerial guidance on how to react once a crisis has started (e.g., Archibugi et al. (2013); Brown and Petersen (2015); Paunov (2012)), the findings of studies I to III motivate leadership teams to specifically take preparative actions. Being aware that such preliminary measures are associated with costs, i.e., money and time, measures with a dual benefit, i.e., those that exhibit advantages in both stable and unstable times, are of particular interest. As such, study I suggests that leadership teams should strategically consider innovation as a booster for organizational resilience. While benefits of innovation during stable times are abundantly discussed in prior research (e.g., Adcock et al. (2014); Rubera and Kirca (2012)), a strong innovation focus yields economic and procedural benefits during times of distress. To reap the economic benefits, management teams should push for high-quality, well-filled process improvement and product development pipelines. To realize the procedural benefits, leadership teams are asked to establish an environment of exchange

and trust. The same mechanism holds for the dimension of entrepreneurial orientation, as study II suggests. In both stable and unstable times, entrepreneurial companies profit from a high degree of opportunity recognition, a distinct level of flexibility, and an attractive public image (Han & Zhang, 2021; Lumpkin & Dess, 1996; Monsen & Wayne Boss, 2009).

Second, this research advises management teams to constantly strive for renewal and optimization of their companies' business model and strategic orientation, especially if firm profitability is high. Study I demonstrates that firms with over-average earnings and historical success find it more difficult to utilize their innovation assets during times of distress effectively. In contrast, firms with an inferior level of profitability in the pre-crisis period develop a sense of urgency, making them more attentive and prepared when the actual systemic crisis sets in. As such, my empirical findings strongly suggest that management teams of successful companies should constantly scrutinize their business and innovation activities to keep up with market development, customer expectations, and operational excellence. In essence, CxOs should always find themselves in a state of alertness, as the next crisis might just be ahead.

Third, results of study II recommend CxOs to increase the awareness that generally desirable characteristics of entrepreneurial orientation can have harmful effects if an EO-building strategy is too ambitious. The benefits of an entrepreneurial oriented firm, i.e., recognizing opportunities (Lumpkin & Dess, 1996), reacting flexibly (Han & Zhang, 2021), and exhibiting an attractive public image (Monsen & Wayne Boss, 2009), go into reverse if individuals or the management team as a whole are highly autonomous (e.g., Langfred (2004)), spend money excessively (e.g., Srinivasan et al. (2011)), and show an irrational level of proactivity (e.g., Wihler and Jachimowicz (2016)). In that sense, study II proposes to constantly verify whether the current or planned level of EO is predominantly beneficial, and – if not – take corrective actions. If corrective actions are required, this research advises management teams to foster exchange with stakeholders, review overall investment strategies, and carefully plan ahead to

counterbalance exorbitant autonomy, lavish investment spending, and an unhealthy level of proactivity.

Fourth, my research makes light contributions to the topic of innovation communication to stakeholders. To date, academic research has focused explicitly on the innovation activity itself, i.e., the right amount of innovation spending (e.g., Srinivasan et al. (2011)), or the effects of innovation activity on firm performance (e.g., Atalay, Anafarta, and Sarvan (2013)), while the element of external communication of innovation to stakeholders is covered to a lesser extent (Pfeffermann, Minshall, & Mortara, 2013). Study III touches upon this gap. The results of study III suggest that management should avoid not communicating innovation activities at all, as firms with little to no external communication exhibit the weakest performance in the crisis recovery period. Instead, the findings suggest that leadership teams may choose between strong verbal or factual communication. The research sees positive effects for both communication archetypes when relating to resilience indicators. Hence, study III advises leadership teams to assign equal importance to innovation communication as to the innovation activity itself and make a careful decision on how to express innovation progress.

Fifth and last, all studies I to III determine the level of crisis resilience based on stock price-based measures. While this methodology is backed by existing research (e.g., DesJardine et al. (2019); Sajko et al. (2020)), I suggest leadership teams to carefully consider which indicators are most suitable and reliable when assessing their organization's specific crisis resilience. Depending on industry, size, and business model, alternative KPIs are more suited to indicate whether or not the business is best prepared for systemic shocks.

6.4 Limitations and avenues for future research

This dissertation is based on a thorough literature analysis, a validated conceptual framework, and a solid methodological setup. However, given that the research stream on organizational resilience is still developing, I have to acknowledge a set of limitations that may, at the same

time, guide future research. I structure this chapter into three parts and address the topics of methodological setup, conceptual framework, and literature review.

Methodological setup. Determining the level of innovation plays a central role in studies I to III. I opted to follow established literature and measure innovation based on R&D expenses, patent data, and annual reports (Griliches, 1990; Hall, Thoma, & Torrisi, 2007; Lumpkin & Dess, 1996; Simeth & Cincera, 2016). Even though I consciously chose to assess innovation in three ways, one can argue that these variables cannot fully capture the sheer diversity of innovation activities. I am convinced that my choice is reasonable and leads to fully robust results, but I encourage future researchers to consider additional and alternative innovation measures to verify the relationship between innovation and organizational resilience to reflect innovation's manifoldness. Table 11 contains a list of around 30 measures that could serve as a starting point for alternative innovation variables.

Moreover, I refer to the methodology of study III. I purposely chose to run a cluster analysis that is explorative in nature and hence a typical starting point to gather initial insights and discover new structures in large data sets. Relevant disadvantages relate to weaker statistical robustness compared to, e.g., traditional regression models. More specifically, cluster analyses do not differentiate between dependent and independent variables, do not provide levels of statistical significance, and results are highly dependent on model parameters, e.g., the number of clusters. To overcome these problems on the one hand and to further develop my initial findings, I suggest fellow researchers reproduce study III in a statistically more sophisticated way, e.g., by running regression models with reasonable control and interaction variables.

Table 11: Collection of measures relating to innovation

Category	Measure
Innovation pipeline	Degree of innovation radicality
	Number of projects
	R&D employee hours billed
	R&D headcount
New product releases	Number of newly released products
	R&D return on investment
	Sales from new products
Patents	Degree of (de-)centralization
	Degree of closeness / distance to own industry
	Exploration vs. Exploitation
	Generality index
	Innovation categories
	Innovation stock
	Inventor team size
	Number of citations
	Number of patents
	Originality index
	Patent class
	Patent intensity
	Patent originality
	Patent stock (aggregated patent count)
	Patent stock, citation weighted
	Strategic positioning
	Unconventionality
Perception on innovation	by customers
	by employees
	by shareholder
	by suppliers

Source: own illustration

Conceptual framework. Research studies I to III build exclusively on secondary data from public, U.S. American companies. As such, my studies follow the conceptual approach of prior research (Amore, 2015; Buyl et al., 2019; Gittell et al., 2006; Ortiz-de-Mandojana & Bansal, 2016; Srinivasan et al., 2011) and are in line with the general literature landscape: 13 out 62 articles (21%, Figure 8) have a U.S. America focus, and 41 out of 62 articles (66%, Figure 10) are quantitative in nature. Advantages such as superior data coverage and high data

reliability appear convincing. At the same time, generalization of findings or transfer to other economic, political, and cultural systems might be limited. Even though I am highly convinced that my data set of S&P 1500 companies is a solid basis for analysis, I promote to also consider primary and qualitative research. Primary research will help to precisely tailor questions and data requests to the respective research question. In contrast, qualitative research will help to evaluate why and how individuals or organizations reacted as they did. The research stream of organizational resilience could undoubtedly benefit from moving from proxies and hypotheses to tailored data and actual rationales.

In my studies, I operationalized organizational resilience in three ways, always referring to stock price developments. Study I disaggregates organizational resilience into the components of flexibility and stability, thus following DesJardine et al. (2019) and Sajko et al. (2020). Study II, in contrast, is based on a novel approach and measures resilience by evaluating ultra-short-term market reactions in an event study setting. While the event study approach already addresses a call for research suggested by Linnenluecke (2017) and Hillmann and Guenther (2021), I would like to motivate further researchers to identify and experiment with alternative measures of organizational resilience. An exciting and promising approach could be to develop a measure that is entirely different from traditional, firm performance-like metrics. Most likely, it will be a blend of various components that in aggregation constitute organizational resilience.

To conclude this chapter on limitations and avenues for future research, three points stand out. First, my research can be further developed by integrating alternative innovation measures and considering alternative concepts to determine organizational resilience. Second, the methodology can be fortified by verifying my findings in study III through advanced statistical methods. Third, further research can be inspired by considering more experimental and innovative articles that are not covered by renowned academic journals and by following a data-driven approach for the literature review.

6.5 Final conclusion

A recent publication of McKinsey from March 23, 2022, raises serious concerns that organizations are well equipped for the next crisis:

> "McKinsey's annual global board survey of approximately 1,500 corporate directors found that [...] only 40 percent say their organizations are prepared for the next large crisis." (McLaughlin, 2022)

With the COVID-19 pandemic just ending – or maybe only pausing – and the aggressive war of Russia on Ukraine in progress, my dissertation addresses a topic that can hardly be missed by academia and ignored by management: How can organizations become more resilient by leveraging their innovation and entrepreneurial assets under consideration of their firm-specific conditions?

By building on prior research, relating to established theories, and empirically testing influential factors on organizational resilience, I constitute three main findings. First, innovation activities and entrepreneurial behavior do not only drive business in stable times but, more importantly, also soften crisis-related losses during systemic crises. As such, I assign innovation and entrepreneurship a dual role of benefits. Second, the effectiveness of innovation and entrepreneurship are contingent on pre-crisis profitability and financial leverage. Firms with lower pre-crisis profitability and a thus higher sense of urgency can better use their innovation assets in times of distress. Financial leverage mitigates the harmful effects of an overly ambitious entrepreneurial orientation strategy, thus increasing organizational resilience. Third, communication of innovation progress is as important as the innovation activity itself. Companies that actively communicate their achievements through words or facts show better performance in the crisis recovery period than silent companies.

Overall, I hope that my research guides the academic research stream of crisis management in general and organizational resilience in specific and motivates management teams to fortify their organizations such that upcoming systemic crises constitute an economic break rather than an organizational breakdown.

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Part B: Research studies

Part B contains my three independent, stand-alone research studies that represent the core of my dissertation. The studies answer the research questions outlined in chapter 2.3 and fill the identified research gaps. The structure of studies I and II is similar and consists of an abstract, introduction, methodology, results, discussion, conclusion, and references chapter. Due to the exploratory approach, the format of study III differs slightly.

I developed all research studies with the valuable support of my supervisor Prof. Dr. Andreas Engelen; study II has been additionally enriched by beneficial input from Dr. Anna Gründler in cooperation with Johannes Klein-Peters, a former master's degree candidate. As such, the articles are written from the perspective of the first person plural (we/our).

Research study I

SHOCK ABSORBER: CUSHION SYSTEMIC SHOCKS AND BUILD A RESILIENT ORGANIZATION THROUGH PRE-CRISIS INNOVATION

ABSTRACT

This study explores how pre-crisis innovation influences organizational resilience in systemic crises. Based on the 2008 Great Financial Crisis, we empirically examine firms' organizational stability and flexibility subject to their strategic emphasis on innovation, operationalized through accounting and patent-based measures. We can strongly confirm our hypotheses that pre-crisis innovation is beneficial in times of systemic distress and found even stronger associations for companies that economically underperformed before the crisis's onset. Our findings are theoretically backed by the resource-advantage and the network theory and expand established crisis management and innovation-focused research. Managerial implications constitute that leadership teams are in the position to pro-actively mitigate systemic crisis-related losses by leveraging economic and procedural benefits of innovation. We base our empirical analysis on a sample of S&P 1500 companies.

INTRODUCTION

The prevailing COVID-19 pandemic is the most recent example of a systemic shock, yet by far not the only one with a global reach. Solely by considering the past 50 years, we saw economies dealing with a variety of major downturns, including the OPEC Oil Price Shock (1973), the International Debt Crisis (1982), the Black Monday (1987), the Asian Crisis (1997), the dot-com bubble (2000), the 9/11 attacks (2001), the Great Financial Crisis (GFC, 2008) and the aforementioned COVID-19 pandemic. Both the pure number of and temporal proximity between these recessions indicate that the statistical likelihood of CxOs experiencing at least one significant crisis in their professional career is high. Consequently, management research attaches high importance to how executive teams can alleviate economic consequences for their firms, thereby motivating the research stream of organizational resilience (Linnenluecke, 2017).

While current literature on organizational resilience extensively discusses the impact of, e.g., supply chain management (Craighead, Blackhurst, Rungtusanatham, & Handfield, 2007; Pettit, Fiksel, & Croxton, 2010), business models (Gittell, Cameron, Lim, & Rivas, 2006) or CSR investments (DesJardine, Bansal, & Yang, 2019; Sajko, Boone, & Buyl, 2020), we found the influence of innovation not only sparsely covered but also only measured during – and not prior to – the crisis period (Linnenluecke, 2017). As such, Archibugi, Filippetti, and Frenz (2013b) found that companies reduce R&D investments in economic crisis periods as potential returns are uncertain and long-term. The authors further stress the benefits of explorative product and growth strategies to mitigate crisis-related losses (Archibugi, Filippetti, & Frenz, 2013a). Devece, Peris-Ortiz, and Rueda-Armengot (2016: 5366) revealed that "innovation and opportunity recognition are more relevant as success factors during periods of recession than during periods of prosperity." In general, we see that academic guidance on managing innovation activities to master adverse situations better is reactionary, i.e., in-crisis focused, rather than proactive, i.e., pre-crisis focused.

We aim to complement our understanding of innovation's role in crisis management and argue that pre-crisis innovation activities are an essential lever to mitigate crisis consequences. Specifically, we expect pre-crisis innovation to contribute to organizational resilience in two ways. First, through the economic component: innovation improves performance and generates firm value through additional profit. It creates competitive advantages and customer retention, thereby potentially mitigating crisis-related losses. Second, through the procedural component: by undergoing the innovation process, both individuals and the organization learn from the practice, align on common perspectives, and acquire a set of transferable skills and capabilities. As such, Ortiz-de-Mandojana and Bansal (2016) name a variety of characteristics, e.g., goal orientation, learning from failures, loyalty, pragmatism, shared visions, or trust, that are required to create a new and improved product and service offering. These common grounds of practices, attitudes, and non-explicit communication form invisible bondages. These make employees think and act along similar lines without the need for time-consuming, cumbersome, formal coordination. We argue that these procedural, innovation-originated benefits are transferable to other contexts, e.g., to times of distress.

While these thoughts suggest that pre-crisis innovation activities might mitigate the consequences of crises, we know little about how this mitigation manifests. To examine these effects of pre-crisis innovation in-depth, we follow DesJardine et al. (2019) and Sajko et al. (2020) and differentiate between severity of loss and time to recovery as major facets of organizational resilience. Severity of loss, operationalized through the percentage drop a company's stock price experiences shortly after the crisis's start, represents a firm's stability (DesJardine et al., 2019). Companies that experience softer stock price drops are more stable as their economic and organizational setup is more robust against external threats. Time to recovery, operationalized through the number of days it takes for a firm's stock price to return to its immediate, pre-crisis level, represents a firm's flexibility (DesJardine et al., 2019). Companies that recover quicker are more flexible as they can better adjust to the environmental changes following the

crisis event (Brand & Jax, 2007). To shed further light on the innovation-resilience relationship, we embed our investigations into a contingency perspective. We argue that a firm's pre-crisis economic performance also plays an important role. We empirically test our hypotheses by analyzing the pre-2008 GFC innovation activities of S&P 1500 companies and relating them to the above-described proxies for organizational resilience. We measure a company's pre-crisis innovation activity through accounting and patent-based variables.

By combining the domains of innovation and organizational resilience research, our study contributes to the respective literature in three major ways. First, we extend the positive implications that established research grants to innovation activities (Rubera & Kirca, 2012). Specifically, we contribute to the literature investigating the role of innovation in crisis settings. We add that the pre-crisis level of innovation is an essential means to buffer negative crisis consequences. Thus, we establish that innovation does not only play a role once a crisis sets in but also acts as a kind of "insurance" against crisis consequences. Second, we establish innovation, and more specifically pre-crisis innovation, as an antecedent of organizational resilience. In this way, we contribute to resilience research at the firm level, which has so far focused on operational (Craighead et al., 2007; Pettit et al., 2010), business model (Gittell et al., 2006), and stakeholder (DesJardine et al., 2019; Sajko et al., 2020) factors. We demonstrate that a strategic focus on innovation activities is an important antecedent and show the promise of research at the interface of innovation and resilience literature. Third, we inform the literature on crisis management that the pre-crisis level of performance is a vital contingency factor when evaluating the effectiveness of antecedents to crisis mitigation. We theoretically establish and empirically validate that firms in an "urgency mode" – due to poor firm-level performance prior to the crisis's onset – particularly profit from innovation as an element for crisis mitigation.

CONCEPTUAL BACKGROUND AND HYPOTHESES

Organizational resilience comprises stability and flexibility

The concept of resilience has its roots in the area of ecology. It describes the capacity of an ecosystem to absorb repeated disturbances or shocks in the first place and to adapt without fundamentally switching to an alternative stable state in the second place (Holling, 1973). Based on the original idea of flora and fauna reacting to a sudden or gradual change in environmental conditions, other disciplines adopted and modified the concept to fit their domain. The American Psychologist Association defines resilience as "the process of adapting well in the face of adversity, trauma, tragedy, threats, or significant sources of stress." They add that it "involves 'bouncing back' from [...] difficult experiences [and subsequent] profound personal growth" (American Psychological Association, 2012). In material sciences, resilience is understood as the "ability of a material to absorb energy under elastic deformation and to recover this energy at removal of load," resulting in the material springing back into its original state (Vegas & Del Martin Yerro, 2013: 924)

In management research, resilience comprises characteristics that enable organizations to respond faster to adverse situations, recover quicker from sudden downturns, or develop superior solutions in a new business environment (Vogus & Sutcliffe, 2007). To date, organizational resilience is frequently related to psychological strengths at an employee level (Coutu, 2002; Luthans, 2002a, 2002b), to the adaptability of business models (Gittell et al., 2006; Hamel & Välikangas, 2003; Sutcliffe & Vogus, 2003), and to operational stability through fortified supply chains (Christopher & Peck, 2004; Paul & Saad, 2021; Ponomarov & Holcomb, 2009; Raj Sinha, Whitman, & Malzahn, 2004; Rice & Caniato, 2003). Having experienced four major global crises in the past 25 years alone (i.e., dot-com, 9/11, GFC, COVID-19), organizational resilience carries a high potential value and is "a desirable characteristic [...] to possess in order to deal with various types of adversity" (Linnenluecke, 2017: 4).

Irrespective of the research domain, all definitions share the common idea that the concept of resilience comprises two components: stability and flexibility. The first component, stability, is short-term oriented and addresses the subject's immediate reaction to an external shock. In management research, organizations are considered stable if they remain intact and manage to keep core functions and processes running, despite dynamic environmental changes (Weick, Sutcliffe, & Obstfeld, 1999). The second component, flexibility, is mid- or even long-term oriented and addresses the subject's post-shock path to its pre-shock state. In management research, organizations are considered flexible if they realize crisis-related environmental changes quickly, identify potential adjustments thoroughly, and naturally adapt to the new situation (DesJardine et al., 2019). In combination, resilient organizations can absorb disturbances in the short-term (stability) and transform their organizational structure and business activities in the mid- to long-term (flexibility) to efficiently master critical events.

Even if disaggregated into stability and flexibility, organizational resilience remains a theoretic concept whose existence or level of achievement cannot be observed and measured directly (Brand & Jax, 2007). Instead, it needs to be derived from other, more tangible constructs. Following the approach of DesJardine et al. (2019) and Sajko et al. (2020), we assess organizational resilience through a firm's stock price development following a crisis. The stability component is proxied through the percentage drop in stock price, also referred to as severity of loss. The flexibility component is proxied through the number of days it takes a firm's stock price to recover to its pre-crisis level, referred to as time to recovery. While the two measures are conceptual, contextual, and mathematical distinct, they are logically linked. Considering a highly resilient firm, we expect only small losses (observed through a soft stock price drop) and hence better chances for a quicker recovery (observed through a low number of days). In contrast, we expect non-resilient firms to experience higher losses (observed through a strong stock price drop) and hence reduced chances for a quick recovery (observed through a high number of days).

A strategic emphasis on innovation strengthens the business

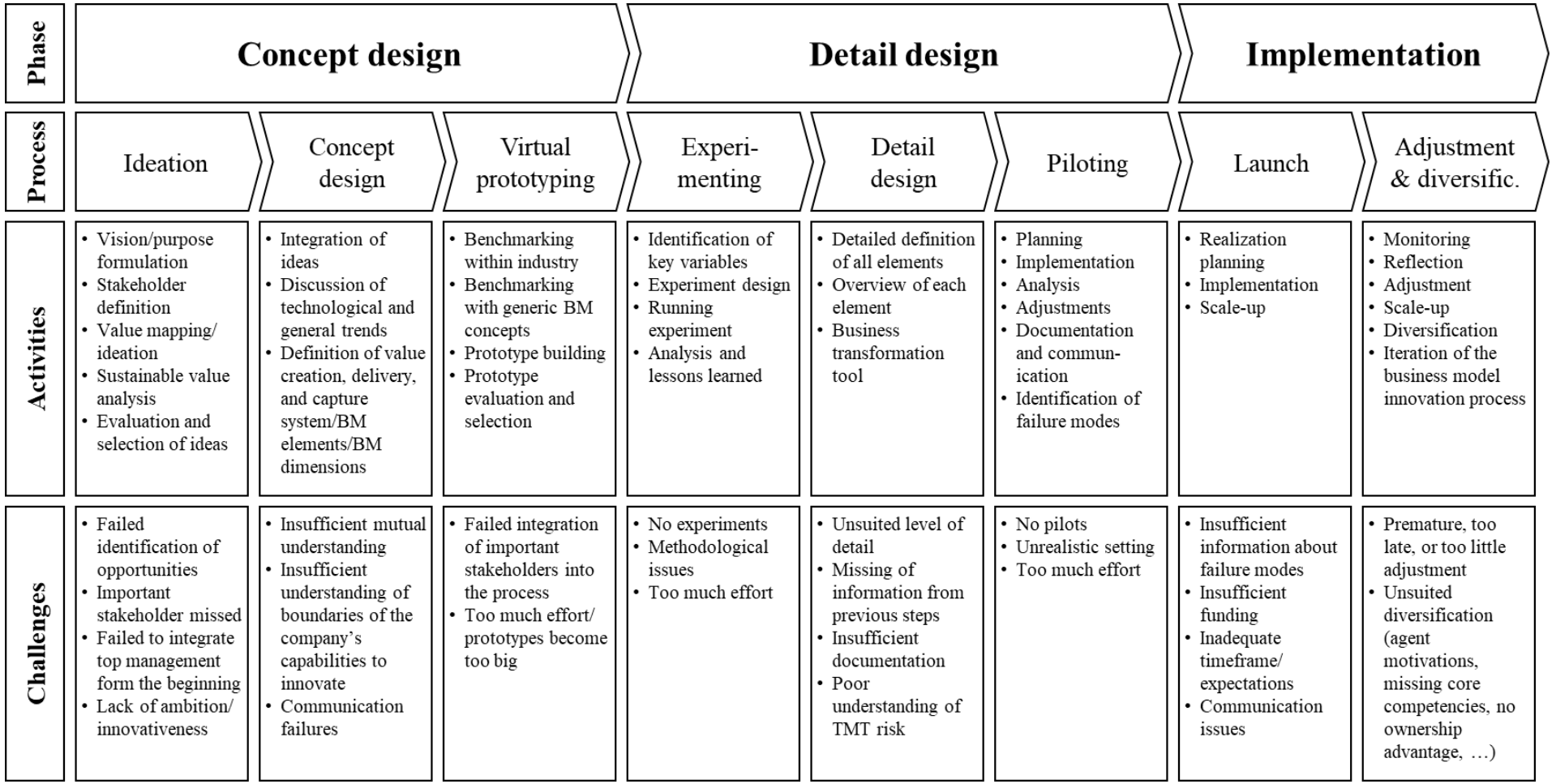
To date, many aspects of innovation, e.g., impact, contingencies, dependencies, antecedents, and descendants, are broadly understood in a variety of contexts. Rubera and Kirca (2012) name several meaningful innovation-performance relationships, such as the positive effects of innovativeness on market position, financial position, and firm value. These base on the idea that innovative firms gain a temporary, quasi-monopoly position that enables them to earn over-average profits (Schumpeter, 1942). Research from Sood and Tellis (2009) and Srinivasan, Pauwels, Silva-Risso, and Hanssens (2009) enriches these findings by relating innovation activities to stock market returns. Cefis and Marsili (2006) explored the relationship between innovation and survival probability of manufacturing firms and name learning, entrepreneurial orientation, and technological focus as influencing factors. Additional work addresses the effects of innovation on customer satisfaction (Dotzel, Shankar, & Berry, 2013; Rubera & Kirca, 2017; Stock, 2011), on employer branding and talent attraction (Andreassen & Lanseng, 2010; Ferris, 2001; Sommer, Heidenreich, & Handrich, 2017), and even on societal structures (Fontan, Jean-Marc, Klein, Juan-Luis & Tremblay, 2004; Owen, Bessant, & Heintz, 2013). Considering all this, we infer that the benefits of a strategic emphasis on innovation are manifold and propose a split between those with an economic and those with a procedural character.

In this paper, economic benefits of innovation relate to gains that enlarge or improve a firm's product and service offering or facilitate production processes and service delivery to better compete in the market. This understanding fits the perspective on innovation that Baregheh, Rowley, and Sambrook (2009) distilled from around 60 definitions in scientific papers. Economic benefits typically materialize in additional turnover through increased sales, reduced costs through efficiency gains, and increased profits as the combination of both.

In contrast, procedural benefits of innovation relate to gains that emerge from the pure "doing," i.e., from experiencing and undergoing the innovation process from start to end. We argue that the inherent activities build common ground within the organization: through

stronger ties and aligned guardrails among all stakeholders on the one hand and a universally applicable character to non-innovation tasks on the other hand. Prior literature backs our argumentation. Geissdoerfer, Bocken, and Hultink (2016) outlined a universal innovation process typified by numerous iterations and feedback loops between the subordinate activities and challenges (Figure 1). Our line of reasoning focuses on five of these elements: Shared vision (ideation phase), discussion of trends (concept design phase), prototype building, evaluation and selection (virtual prototyping phase), experimenting, and product or service release (launch phase).

Figure 1: The Cambridge business model innovation process



Source: Geissdoerfer et al. (2016)

First, Loon Hoe (2007: 12) describes the benefits of working along a shared vision as something that "helps to create a sense of commonality within the organization and provide coherence to varied activities. People who truly share a vision are connected and bound together by a common aspiration." Regarding the innovation process, formulating a vision or purpose for a new product line is an early yet critical task. Second, Morgan, Vorhies, and Mason (2009: 909) reviewed the relationship between market orientation and firm performance and state that discussions of trends have "a direct [positive] effect on firms' return on assets (ROA)." These findings appear intuitive and represent the idea that an extensive exchange between individuals and across divisions helps to develop an approximation of the future. Third, the steps of building, evaluating, and selecting a prototype require and strengthen a working mode that is particularly critical in times of uncertainty, time pressure, and cost-consciousness. Key aspects are high development speed and validated learning (Sharp & Hall, 2016). While these features are natural for prototype development, we expect them to promote an execution-focused behavior in other business contexts. Fourth, we see benefits in experimentation. Experimentation allows companies to find the optimal solution, is cost-efficient, and generates quick and direct feedback (Jenkins, 2014; Thomke, 2020). Equally important, experimentation supports employees' capabilities to deal with and learn from setbacks and failures, in particular, "when answers are not knowable in advance because this exact situation hasn't been encountered before and perhaps never will be again." (Edmondson, 2011: 6). Fifth, and last, a company needs to master the product launch – the essential step to reap the economic benefits of the preceding innovation process. According to Benedetto (1999), launches are particularly successful if prepared and managed by cross-functional teams. As cross-functional teams and separate divisions must deliver a comprehensive and aligned launch concept, we expect profound skills in project management. These skills materialize in activities such as managing the work of many individuals, aligning the goals of different divisions, and sticking to an often tight, pre-defined schedule.

Most likely, organizations become better at these project management tasks if they repeat the inherent activities regularly.

To summarize the subchapter of procedural benefits of innovation, we point to a duality of gains: in the first place, having a shared vision, discussing future trends, building prototypes, pursuing experiments, and launching the final product, are essential steps in a successful innovation process. More importantly, however, we consider the learnings and capabilities emerging from the innovation process to be universally applicable to other contexts. As such, they contribute to an overall strengthened business.

Based on prior work, we argue that a strategic emphasis on innovation strengthens a business, specifically through economic and procedural effects.

Pre-crisis innovation and organizational resilience

From acknowledging the myriad benefits of innovation, we infer that a strategic emphasis on innovation does not only support a business in stable times but also influences a firm's performance during crises. We expect a positive relationship between the two so that more intense pre-crisis innovation activities stronger mitigate the detrimental effects of systemic shocks. While such an association appears intuitive at first thought, the exact mechanics and contingencies are, to date, unknown and hence investigated in this study. To assess how well a company copes with adverse situations, we consider the concept of organizational resilience and follow DesJardine et al. (2019) and Sajko et al. (2020) in distinguishing between organizational stability and organizational flexibility.

To evaluate organizational stability, we observe how companies experience and manage the immediate, post-shock period (DesJardine et al., 2019). In the period directly after the systemic crisis's onset, firms need to remain organizationally intact and ensure the continuation of their core functions and processes. We argue that high levels of pre-crisis innovation support the feature of stability in several ways. First, due to high levels of pre-crisis innovation, a firm

is used to set up small teams with light approval processes, senior leadership presence, sufficient financial backing, and decision-making authority. All this enables an agile working mode (Kalavar & Mysore, 2017) and thus contributes to organizational stability. Second, due to high levels of pre-crisis innovation, an organization learns how to align conflicting goals. This skill helps unite the often contrasting requirements for successful crisis management, such as experience vs. belief, order vs. flexibility, or command vs. coordination (Heath, 1998), and thus strengthens organizational stability. Third, due to high levels of pre-crisis innovation, employees acquire skills to think and act creatively. Acting in extraordinary ways and advancing beyond standard problem-solving strategies help to gain comparative advantages in challenging times (James, Wooten, & Dushek, 2011) and thus contribute to increased organizational stability. Fourth, due to high levels of pre-crisis innovation, a firm has sufficient experience in managing diverse types of stakeholders, e.g., suppliers, customers, investors, and authorities. This capability empowers a company to acknowledge and appreciate stakeholders' roles as heroes, allies, rescuers, protectors, victims, villains, and enemies in times of distress (Pearson & Mitroff, 1993) and thus supports organizational stability.

While all these activities are mentioned explicitly in crisis management literature, the demanded skills and required capabilities resemble those practiced in the innovation process (Gunday, Ulusoy, Kilic, & Alpkan, 2011; Kahn, 2018; Massey, Montoya-Weiss, & Brown, 2001). Therefore, we divide the respective benefits of innovation into an economic and procedural component and consider the latter one particularly beneficial for supporting a firm's organizational stability in adverse situations. Procedural benefits provide the basis for an aligned vision and mindset so that communicating, thinking, and acting happens intuitively, without the explicit need to constantly apply formal guardrails. All this is important as decision speed and coherent actions are precious in stabilizing an organization right after a systemic crisis's onset. Hence, we expect procedural benefits of innovation to lead to smoother, speedier, and better-

backed results that support the organization's proper functioning despite systemic, external threats. Thus, we hypothesize:

Hypothesis 1a (H1a): Pre-crisis innovation positively affects organizational stability once a systemic shock sets in.

To evaluate organizational flexibility, we observe how companies pursue the path to recovery, i.e., how they manage the mid- to long-term post-shock period (DesJardine et al., 2019). Firms are considered organizationally stable when the likelihood of recovery is high and the time to recovery is short. In the period of recovery, organizations need to be flexible: they need to realize environmental changes, work out appropriate measures for adjustment and initiate an adaptation process so that they can eventually generate profits. These financial gains realized through additional revenue or reduced costs boost firm value (Varaiya, Kerin, & Weeks, 1987) in the case of publicly listed firms conveyed through stock price gains. From our prior elaboration on the benefits of innovation, we expect that both the economic and procedural components positively influence flexibility and hence business recovery in the subsequently described ways.

Economic benefits of innovation relate to gains that enlarge or improve a firm's product and service offering or streamline or facilitate production processes and service delivery (Bergfors & Larsson, 2009). Due to high levels of innovation, firms will release new and enhanced products that stimulate customer purchases, thereby contributing to the firm's revenue (Boone, 2000). Alternatively, companies can direct innovation activities towards process improvement, thereby realizing efficiency gains in production or service delivery; these materialize in reduced costs. In both cases, innovation's economic component contributes to additional profit, thereby directly supporting firm recovery.

Procedural benefits of innovation support firm recovery indirectly, namely through flexibility. We expect an impact in two ways. First, due to high levels of innovation, companies are

highly familiar with improvisation, thereby becoming organizationally more flexible. The innovation process itself fosters the capability to improvise as dealing with numerous activities, challenges and unknowns inherently demands and strengthens spontaneity and acting under incomplete information (Kamoche & Cunha, 2001; Vera & Crossan, 2005). Second, due to high levels of innovation, employees share an aligned vision, mindset, and working style so that communication, thinking, and acting happen intuitively (Melnyk & Davidson, 2009; Pearce & Ensley, 2004). The results, e.g., seamless exchange, quick decision-making, mutual trust, and a tolerance for failures, enable firms to react flexibly to unforeseen and unknown situations. These skills and capabilities appear beneficial in times of distress in which different employees and functions need to join efforts to regain a company's pre-crisis strength. Since we argue that these characteristics are not limited to the innovation process itself but have a universally applicable character, we expect innovative and hence flexible firms to better recover from a systemic shock. To conclude, we expect both economic and procedural benefits of innovation supporting organizational flexibility in the first and firm recovery in the second place: either indirectly through collaborative thinking and acting or directly through additional profits. Thus, we hypothesize:

> *Hypothesis 1b (H1b): Pre-crisis innovation positively affects organizational flexibility once a systemic shock sets in.*

We further acknowledge that a systemic shock hits a firm in a given situation and consider this very situation to determine the focal firm's preparedness to react. In particular, we expect that it matters for our study whether a firm is already in a crisis-like mode when the systemic shock sets in and establish financial underperformance as an indicator of firm-level distress. Specifically, distressed firms can switch into a "crisis mode" – at least to some degree – even before the systemic downturn unfolds. Therefore, we eventually argue that the degree

of firm-level distress matters for our purpose and reflect the underlying mechanics through moderation.

The moderating role of pre-crisis performance

Realization of innovation's benefits does neither happen automatically or by chance, nor immediately. Instead, innovation groundwork needs to be "activated" in order to generate financial returns (Wagner & Wakeman, 2016). This activation can take different forms and depends on the type of innovation. Internal process improvements, as the first example, need to be implemented and accepted by the workforce to generate sustainable cost savings. Product ideas, as the second example, need to be made market-ready and offered to the customer to generate additional revenue. Patents, as the last example, have an even longer way to go, as they first need to be transformed into product ideas, which are then converted into market-ready products. Such an activation might be driven by internal or external forces. Internal forces may comprise an ambitious management team that expects continuous and high-quality product releases. External forces may comprise investors, e.g., banks, funds, or shareholders' associations, aiming for high dividends or a strong stock price performance. Especially for external forces, exerted pressure can be tremendous and push a firm to truly focus on innovation (Somé, Cano-Kollmann, Mudambi, & Cosset, 2021). Based on these internal and external forces, we introduce the contingency of "sense of urgency" linked to the command to pursue a strategic change.

Prior research theorizes that the duration and intensity of a firm's past performance influence the inclination to strategic change (Haleblian & Rajagopalan, 2005) such that a track record of superior past performance discourages strategic change, while a track record of inferior past performance encourages strategic change (Yu, Minniti, & Nason, 2019). Kirtley and O'Mahony (2020) explain that firms shift their strategic direction by adjusting activities, resources, and attention to address persisting problems, such as financial underperformance. Early organizational literature adds that the pressure to shift a strategic focus builds

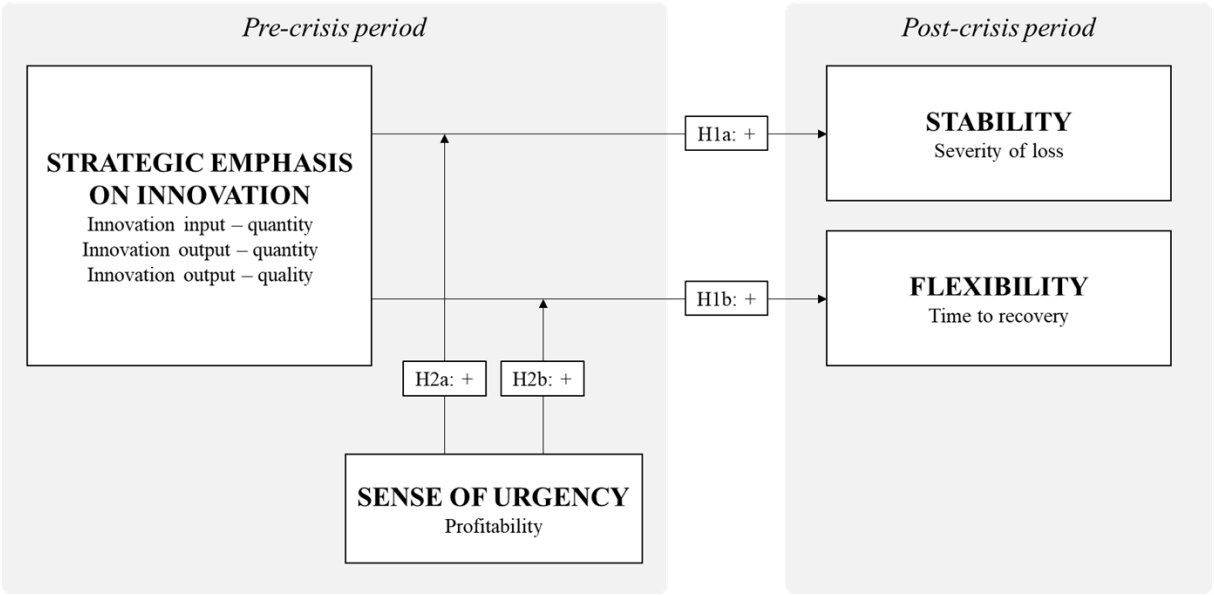
incrementally so that actual change only happens after a longer period of sustained underperformance (Tushman, Newman, & Romanelli, 1986). As such, a systemic crisis only adds up to the existing pressure on strategic change so that the overall sense of urgency even increases. Building on this, we expect that firms that underperformed in the pre-crisis period had – in difference to their better-performing peers – already thought of, planned for, or even started implementing corrective actions when the economy-wide shock set in. Extant literature found that these corrective actions frequently go along with revisiting innovation activities (Bromiley & Harris, 2014; Chen & Miller, 2007; O'Brien & David, 2014; Shinkle, 2012) such that activating innovation groundwork is a quick, viable, and sustainable option to improve performance. Thus, our argument is that pre-crisis, firm-level profitability can set the stage for an organization to be particularly prepared when an even bigger, systemic shock sets in. Hence, we complete the previous hypotheses by:

> *Hypothesis 2a (H2a): Associations between pre-crisis innovation (i.e., the firm-level innovation before a systemic crisis) and organizational stability are stronger when pre-crisis firm-level profitability is low.*

> *Hypothesis 2b (H2b): Associations between pre-crisis innovation (i.e., the firm-level innovation before a systemic crisis) and organizational flexibility are stronger when pre-crisis firm-level profitability is low.*

We graphically summarize our research model as follows:

Figure 2: Research model



Source: own illustration

METHODOLOGY

Sample and time frame

To test our hypotheses, we constructed a sample of public U.S. corporations listed on the S&P 1500. This composite index combines three leading indices for large-, mid-, and small-cap companies to cover approximately 90% of U.S. market capitalization (S&P Dow Jones Indices LLC, 2020b).

In line with prior work, we defined September 17, 2008, as the starting date of the GFC following both Bank of America's acquisition of Merrill Lynch and Lehman Brothers' bankruptcy filing on September 15, as well as the U.S. Federal Reserve's bailout of AIG on September 16, 2008 (DesJardine et al., 2019; Isidore, 2008; Sajko et al., 2020). As a reaction, investors withdrew $144 billion from U.S. money market funds on September 17, thereby causing the short-term lending market – highly important for corporations to fund their daily operations – to freeze (Gullapalli & Anand, 2008).

We consider the GFC an ideal setting for testing our hypothesis: it was unprecedented in its duration and depth, had a global impact, happened unexpectedly, and was sufficiently long to trace effects thoroughly (see appendix A for further substantiation).

We collected data from several sources, together covering the years 1998 to 2019. The 22-year-long period enabled us to construct measures and models flexibly and consider the impact of time. Company fundamentals, e.g., balance sheet accounts and profit and loss items, as well as industry classifications and company identifiers, were obtained from Compustat for the years 1998 to 2015. Daily stock price information was extracted from the Center of Research in Security Prices (CRSP) database for the years 2008 to 2013. Patent data was obtained from the United States Patent and Trademark Office (USPTO) and included application, filing, and citation information for the years 1998 to 2019. These three sources were completed by information on index constituents and crosswalks between Compustat, CRSP, and USPTO databases.

To construct the final cross-sectional sample, we identified all companies that were part of the S&P 1500 Composite Index as of September 16, 2008, i.e., one day before the GFC starting date, and obtained 1,497 results. An asynchronous timing of drop-outs and additions explains the difference of three: while drop-outs are recorded immediately, additions are carried out only once per month (S&P Dow Jones Indices LLC, 2020a). Then, we linked the different data sets to construct the required dependent, independent, and control variables.

First, we joined the entire Compustat database to our sample, leaving us many options to work with a diverse set of measures in the modeling phase. The Compustat variable "Research and development expenses" is highly critical for our analysis, yet it is only available for 39% of our sample companies. Due to the limited availability of R&D expense data, we investigated the possibility of a sample selection bias but are confident to reject any concerns (see appendix B for more details).

Second, we added daily stock price information from CRSP. For 1,343 firms, we were able to find exactly one security per company; for the remaining 154 companies, we identified up to four simultaneously listed stocks. Companies' primary motivation to introduce additional share classes is the possibility of equipping them with particular voting and dividend characteristics. Since these characteristics influence share price and stock performance, we refrained from consciously selecting one specific asset per company. Instead, we decided to work with trading volume-weighted stock prices to blend differences in stock prices and relative performance over time. Ultimately, our stock price-based measures share the same characteristics as those calculated by DesJardine et al. (2019) and Sajko et al. (2020).

Third, we combined USPTO patent data consisting of application, patent, and citation information. In the absence of a natural, mutual unique identifier, the matching process between company fundamentals and patent data represents a critical task for researchers. To ensure a high-quality mapping, we proceeded in three steps: (1) we linked Compustat and USPTO data with a publicly available crosswalk created and maintained by Kogan, Papanikolaou, Seru, and

Stoffman (2017), (2) we verified 10% of the matches manually and (3) we ran a statistical test to identify differences in means (see appendix C for further substantiation).

Fourth and last, we dropped seven firms due to unresolved data inconsistencies between company fundamentals, stock price information, and patent data. Accordingly, our grand sample consists of 1,490 out of 1,500 maximum possible firms (99.3%). Considering the limited presence of R&D expenditure and patent data, the number of actual observations entering our models varies according to the number and type of data-restricted variables. For our base scenario, which tracks the dependent variables over the immediate five-year pre-crisis period, we observe 547 companies with R&D data, and 660 companies with patent data, out of which 646 hold patents with forward citations (see Table 3). We ran our models with observation windows ranging between 1 and 10 years for the pre-crisis and between 1 and 5 years for the post-crisis period.

Measures

Descriptions of our measures and data sources are briefly presented in Table 1.

Table 1: Variable key

Variable	Description	Source
Dependent variables		
Severity of loss	Absolute percentage loss in stock price in the 12 months following the start of the GFC: | [(minimum stock price between September 17, 2008 and September 16, 2009) / (closing stock price on September 16, 2008)] – 1 |	CRSP
Time to recovery	No. of days until stock price reached pre-GFC level (i.e., the closing price on September 16, 2008)	CRSP
Independent variables		
Innovation input - quantity	Capitalization of yearly R&D expenses based on a declining-balance formula with constant depreciation; log(1+x) transformation is applied	Compustat
Innovation output - quantity	Capitalization of yearly patent count based on a declining-balance formula with constant depreciation; log(1+x) transformation is applied	USPTO
Innovation output - quality	Capitalization of yearly forward citation count based on a declining-balance formula with constant depreciation; log(1+x) transformation is applied	USPTO
Instrumental variables		
Index count	No. of unique stock market indexes a company has been part of	CRSP
Index presence	No. of days a firm has been listed in the S&P 1500 index	CRSP
No. of employees	Natural logarithm of the number of company workers as reported (mean)	Compustat
Control variables		
Firm age	No. of years between 2008 and the year the firm was first covered by Compustat	Compustat
Firm size	Natural logarithm of total assets (mean)	Compustat
Profitability	Ratio of earnings before interest, tax, depreciation, and amortization (EBITDA) to book value of total assets (mean)	Compustat
Capital intensity	Ratio of capital expenditure to book value of total assets (mean)	Compustat
Financial leverage	Ratio of long-term debt to book value of total assets (mean)	Compustat
Intangible assets	Natural logarithm of ratio of market value per share to book value per share (mean)	Compustat
Slack resources	Ratio of long-term debt to market value of equity (mean)	Compustat
Pre-crisis stock price	Closing stock price on September 16, 2008	CRSP
Industry dummy	Dummy variable representing the industry division based on a 2-digit SIC code	Compustat
Year-month dummy	Dummy variable representing the year and month in which stock price reached its minimum	-

Abbreviations: CRSP = Center for Research in Security prices; EBITDA = Earnings before interest, tax, depreciation, and amortization; GFC = global financial crisis; R&D = research and development; SIC = Standard industrial classification; USPTO = United States Patent and Trademark Office
Note: (mean) indicates that simple averages are used if independent variables are measured for multiple years

Dependent variables

In line with prior work of DesJardine et al. (2019), our dependent variables, i.e., severity of loss and time to recovery, measure two outcomes of organizational resilience based on stock price data. In contrast to other researchers, however, we decided to work with daily instead of monthly closing prices, thereby increasing our models' precision.

Severity of loss. We followed DesJardine et al. (2019) and Sajko et al. (2020) and computed the severity of loss as the absolute percentage change in each company's stock price between the closing price prior to the onset of the GFC, i.e., as of September 16, 2008, and the lowest point that the stock reached in the following 12-month period, i.e., until September 16, 2009. A high absolute value indicates a large drop in stock price. We adopted the established one-year observation window from related studies (Buyl, Boone, & Wade, 2019; DesJardine et al., 2019; Sajko et al., 2020) to reduce the likelihood that adverse events other than the GFC triggered a stock price minimum.

Time to recovery. We followed DesJardine et al. (2019) and Sajko et al. (2020) and computed the time to recovery as the number of days a company's stock took to reach its pre-crisis level, i.e., the closing price as of September 16, 2008. A high value indicates a long recovery time. By default, we observed stock price recovery within the first 36 months following the crisis, i.e., until September 16, 2011, but lengthened this observation window to 48 and 60 months to check statistical robustness.

Independent variables

To thoroughly evaluate a company's strategic emphasis on innovation, we considered the dimensions of innovation input, output, quantity, and quality to define three distinct variables. Computations of these variables follow the same concept and only differ among the actual data input. As pre-crisis innovation efforts cannot be directly extracted from financial statements, we operationalized our variables through R&D expense and patent data. Irrespective of the fact that R&D expense data does and patent data does typically not appear in a company's annual

(financial) reports, neither of the two is expressed as an accumulated figure. Therefore, we capitalized multi-year data to retrieve a single value per firm and variable, each eventually representing a company-specific, internally-developed, or externally-acquired knowledge or skill asset.

Mathematically, we applied the perpetual inventory formula with a constant depreciation rate (δ); this method is regularly employed by prior work to accumulate innovation-related data (Hall, 2005; Hall & Oriani, 2006; Hall, Thoma, & Torrisi, 2007; Sandner & Block, 2011). Following Griliches (1981) and Hall et al. (2007), we used a depreciation rate of 15% to account for the obsolescence of knowledge and skill assets as time passes.

$$p_t^{stock} = p_t^{flow} + (1 - \delta) * p_{t-1}^{stock}$$

By default, we measured the independent variables over the immediate 5-year, pre-crisis period, i.e., from 2003 to 2007, to reflect that the transformation of innovation efforts into knowledge and skill assets is an ongoing process (Simeth & Cincera, 2016). We reran our models with a 1, 3, and 10-year observation window to test for robustness.

Innovation input - quantity. We operationalized this measure by accumulating yearly R&D expenditure according to the above formula and applied a log(1+x) transformation. Prior work states that "R&D expenditure [...] is usually considered a measure of innovation input rather than innovation output or 'success' of innovative activities" (Hall et al., 2007: 5; Pandit, Wasley, & Zach, 2011) and hence a reasonable proxy for our purposes. In the rare cases in which we missed R&D expense data for single years, we followed Hawthorne and Elliott (2005) and imputed the mean.

Innovation output - quantity. We operationalized this measure by accumulating yearly patent count figures according to the above formula and applied a log(1+x) transformation. Prior work widely confirms that patent count is an appropriate proxy to measure innovation output (Achibugi, 1992; Griliches, 1990; Pavitt, 1985; Savage, Li, Turner, Hatfield, & Cardinal, 2020). As the patenting process, from application to publication, may last several months or

even years, we determined the application date to be relevant for constructing yearly count figures. The benefits of our choice are two-fold. First, a patent application represents the end of a firm's knowledge creation process and therefore connects neatly to our first measure innovation input - quantity. Second, the application date is the earliest and first consistent date in the patenting process and hence well comparable across the heterogeneity of filing characteristics. The publication date, a theoretical alternative, is distorted by many factors outside a firm's reach and consequently less reliable for our purposes.

Innovation output - quality. We operationalized this measure by accumulating yearly forward citation counts according to the above formula and applied a log(1+x) transformation. Researchers use forward citations with varying intents, but all have in common that they relate to quality, impact, and importance of innovation outcomes (Chatterji & Fabrizio, 2012; Hall, 2005; Kotha, Zheng, & George, 2011; Narin & Olivastro, 1988; Simeth & Cincera, 2016). For further substantiation, we refer to the findings of Hall et al. (2007) and Harhoff and Wagner (2009). They confirm that forward citations measure innovation quality as good as alternative proxies, i.e., family size (number of jurisdictions the patent has been applied for), number of technological classes, and direct survey-based measures. When counting forward citations, we decided to follow a conservative approach and excluded self-citations, i.e., citations that refer to another focal firm's patent, for the reason that self-citations might be part of the firm's "managerial strategies to possibly increase the captured value for their entity" (Savage et al., 2020: 1144). We considered all forward citations that appeared within 12 years after the application filing date and assigned the retrieved count to the focal patent's application year. The 12-year observation window fulfills two criteria. First, 12 years is the maximum number of years we can consistently track forward citations (i.e., the last patent application considered is from 2007, while citation data is available until 2019). Second, the 12-year observation period recognizes a substantial amount of all forward citations.

Instrumental Variables

We followed DesJardine et al. (2019) and defined instrumental variables to mitigate potential endogeneity concerns. A valid instrumental variable fulfills two criteria. First, the instrument is correlated with and has a causal effect on the explanatory (a.k.a. independent or predictor) variable of interest. Second, the instrument is not correlated with the response (a.k.a. dependent or outcome) variable. As such, the instrument affects the response variable only indirectly through the explanatory variable. We argue that measures representing a firm's *visibility* meet the required conditions (DesJardine et al., 2019). Prior work supports this view. Dai, Shen, and Zhang (2017: 2) find that media attention's "role in mitigating financial constraints is positively associated with innovation." Wei and Bo (2018: 55) argue that "cross-listed companies [i.e., firms listed on multiple exchanges] have a higher level of innovation than those companies listed only on A-share markets." Finally, Wei and Mei (2020: 255) show "that both media attention and investor attention have a significant positive impact on corporate innovation investment." In contrast, we do not see evidence that visibility impacts stock price performance following major crises; neither customers nor investors will prefer a highly visible company over a non-visible one in times of distress (DesJardine et al., 2019).

Index count. We operationalized this measure by counting the number of unique stock market indexes a firm has been part of. Companies that belong to more indices are visible to a larger and broader audience of investors, media reporters, and the general public than those listed in fewer or no indices.

Index presence. We operationalized this measure by counting the number of days a firm has been part of the S&P 1500 Composite Index. Companies with a longer index presence are visible to a larger and broader audience of investors, media reporters, and the general public than those with a shorter time of stay.

No. of Employees. We operationalized this measure by taking the natural logarithm of the number of company workers reported to shareholders. Firms with a larger workforce and

more intense hiring activities are more visible than those with fewer employees and lower recruiting targets.

Table 2: Instrumental variable analysis: First stage regression results

Variable	**(1) Innovation input - quantity**
Index count	0.05*
	(0.02)
Index presence	0.07***
	(0.02)
No. of employees	-0.38***
	(0.07)
Firm age	-0.04
	(0.03)
Firm size	1.19***
	(0.06)
Profitability	-0.06*
	(0.02)
Capital intensity	0.01
	(0.03)
Financial leverage	-0.07**
	(0.03)
Intangible assets	0.16***
	(0.03)
Slack resources	-0.01
	(0.03)
Pre-crisis stock price	-0.07**
	(0.02)
Constant	0.76***
	(0.20)
Industry dummies	Included
Year-month dummies	Included
Observations	547
Adjusted R^2	0.79
F statistic	35.26***
Durbin-Wu-Hausman	11.18***
Sargan X^2	3.55
Cragg-Donald F-Statistic	17.14***

Note: Values are presented as B (SE) unless noted otherwise; *Profitability* has been centered and standardized; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Control Variables

To isolate the impact of our independent variables, we included ten controls in our study. The selection and calculation of control variables are identical for all models and partly resemble the prior work of DesJardine et al. (2019) and Sajko et al. (2020).

Firm age is the difference between 2008 and the year in which Compustat first covered the company. We assume that older firms have experienced and successfully managed various past crises so that they are more likely to have acquired relevant skills and knowledge to react to adverse events. *Firm size* is the natural logarithm of assets. Findings of Fort, Haltiwanger, Jarmin, and Miranda (2013) show that firm size is a decisive factor when evaluating performance throughout the business cycle; in their study, small businesses are hit particularly hard during downturns. *Profitability* equals the ratio of earnings before interest, tax, depreciation, and amortization (EBITDA) to the book value of total assets. We believe that the cost-income structure of firms does influence investment activities. Besides the variable's use as a control, we employ the metric as a moderator representing a firm's level of sense of urgency. A comparably low level of profitability translates into a high sense of urgency, while a comparably high level of profitability translates into a low sense of urgency. *Capital intensity* is the ratio of capital expenditure to the book value of total assets. As such, Gittell et al. (2006) researched the September 11, 2001 attacks and argued that capital-intensive airlines performed worse than those with less capital employed. *Financial leverage* is the ratio of long-term debt to the book value of total assets. Less leveraged firms obtain a smaller portion of the financing needs from debt and are hence less risky. If investors prefer safer investments during economic crises, highly leveraged firms are hit harder and recover later. *Intangible assets* equals the natural logarithm of market value per share to book value per share. This ratio captures the premium investors are willing to pay for goodwill, brand recognition, and corporate reputation. A higher ratio indicates a higher reputation (or similarly, goodwill and brand recognition) and thus higher expected future performance (Fombrun, Gardberg, & Sever, 2000). *Slack resources* is the ratio

of long-term debt to market value of equity. George (2005) and Mosakowski (2002) discuss how the availability of resources impacts firm performance. In essence, the effects of scarce and slack resources are ambiguous: they can either negatively or positively impact firm performance (e.g., scarce resources may defer essential investments, but they may also enhance capabilities through finding creative solutions; excess resources may allow the management to focus on innovative projects, but they may also mislead decision-makers to undertake other-than-economic projects). We acknowledged this ambivalence by controlling for resource availability. *Pre-crisis stock price* is the closing stock price as of September 16, 2008, and accounts for different absolute price levels. *Industry dummies* are defined by firms' two-digit SIC (Standard Industrial Classification) codes. These dummies absorb all effects specific to an industry and further consider that investors may shift their focus to more stable businesses in challenging times (e.g., to utilities). *Year-month dummies* are composed of the year and month in which a company's stock price reached its minimum value. As such, we included time dummies in each model.

Method of analysis

Since our two dependent variables represent two distinct aspects of organizational resilience and differ in their statistical nature, we specified two distinct models. We employ an OLS regression for the severity of loss variable and a Cox proportional hazard model for the time to recovery measure. As hypothesized earlier, we assume pre-crisis profitability to have a moderating effect on organizational resilience and extended our models with interaction computations.

Analysis of post-crisis stability (severity of loss)

In line with DesJardine et al. (2019), we applied ordinary least squares (OLS) and two-stage least squares (2SLS) regressions to test the relationship between innovation input and output and the severity of loss (hypotheses 1a and 2a). We specified robust standard errors for all our calculations. By default, we tracked the dependent variable, i.e., severity of loss, over one year

(September 17, 2008 to September 16, 2009) and measured the independent, instrumental, and control variables over five years (January 1, 2003 to December 31, 2007).

To address the potential concerns of endogeneity and variable omission, we prepended an instrumental, 2SLS regression. Statistical results of the 2SLS regression as well as a selection of appropriate 2SLS tests, i.e., Durbin-Wu-Hausman, Sargan test, Cragg-Donald test, and Stock-Yogo analysis, support the meaningfulness of our models (see Table 2 and appendix D for detailed results).

Analysis of post-crisis flexibility (time to recovery)

We followed DesJardine et al. (2019) and specified a Cox proportional hazard model to evaluate the impact of innovation input - quantity, innovation output - quantity, and innovation output - quality on time to recovery (hypotheses 1b and 2b). We specified robust standard errors for all our calculations. Survival models are well suited for our analysis as they can handle right censoring and skewed distributions (DesJardine et al., 2019; Sajko et al., 2020). The dependent variable is the hazard rate, derived from the time to recovery variable and expressed as the instantaneous probability that a firm recovers at time t. The mathematical expression equals

$$Hazard\ rate = \lim_{\Delta t \to 0} \left(\frac{P(t, t + \Delta t}{\Delta t} \right)$$

where P(t, t + Δt) is the chance of recovery between time t and t + Δt (DesJardine et al., 2019). In difference to the prior work of DesJardine et al. (2019) and Sajko et al. (2020), we inspected stock price recovery on a daily – not monthly – basis, thereby increasing our models' precision. By default, we tracked the dependent variable, i.e., time to recovery, over three years (September 17, 2008 to September 16, 2011) and measured the independent and control variables over five years (January 1, 2003 to December 31, 2007).

We also examined whether including instrumental variables is justifiable but can eventually reject an integration for two reasons. First, observation periods of dependent and independent variables do not overlap. The independent variables are measured before, and the

dependent variables are observed after GFC's start so that we can exclude direct interaction and reverse causation. Second, we adapted our validity checks for instrumental variables to fit the setup of our Cox proportional hazard model and integrated variables for time to recovery, innovation output - quantity, innovation output - quality, and all instrumental and control variables. Using the Durbin-Wu-Hausman test, we cannot reject the null hypothesis ($F = 2.15$, $p = 0.14$). Hence, we assume no correlation between our regressors and the error term; consequently, we conclude that endogeneity is not a concern.

RESULTS

We arranged this chapter as follows: First, we present summary statistics for our data set. Second, we separately examine the results of post-crisis stability and post-crisis flexibility analysis. Finally, we underline our findings with a series of diagnostic and robustness checks.

Summary statistics

Table 3 provides descriptive statistics as well as the correlation coefficients for each variable presented in Table 1. On average, stock prices dropped by 53% from their pre-crisis level in the 12 months following the GFC's start on September 17, 2008 (severity of loss) and took, on average, 529 days to recover (time to recovery). Table 4 disaggregates this averaged figure by industry division. Roughly 35% of stocks recovered within 12 months (253 firms), 67% recovered within 24 months (476), and 81% within 36 months (582). 12% of stocks did not recover within our five-year observation period (85). The Services division (n = 91) recovered particularly fast, i.e., 48% of firms recovered within 12 months; the finance sector (n = 7) recovered particularly slow, i.e., only 43% of firms recovered within 36 months.

Pure descriptive statistics of our three independent variables are less meaningful as they are an aggregate of capitalized and depreciated flow figures. Particularly high bivariate correlations between our three independent variables (i.e., 0.67, 0.75, and 0.94, Table 3) may indicate multicollinearity concerns. As such, we refrained from using them simultaneously in one model.

For instrumental variables, we observe that firms' stocks were part of 11 to 17 unique stock market indices (index count), resided in the S&P 1500 between 1 and 2,085 days (index presence), and employed up to 1,800,000 workers (no. of employees).

Table 3: n, means, standard deviations, and bivariate correlations

Variable	n	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Severity of loss	715	-0.53	0.18														
2. Time to recovery	630	529.22	374.96	-0.29*													
3. Innov. input - quantity	547	5.40	1.71	0.21*	0.03												
4. Innov. output - quantity	660	3.33	2.08	0.04	0.05	0.75*											
5. Innov. output - quality	646	5.33	2.44	0.04	0.08*	0.67*	0.94*										
6. Index count	715	13.01	1.11	0.12*	0.06	0.31*	0.20*	0.16*									
7. Index presence	715	1868.76	519.89	0.01	0.08*	0.29*	0.20*	0.14*	0.04								
8. No. of employees	715	1.73	1.67	0.03	0.20*	0.57*	0.35*	0.28*	0.19*	0.36*							
9. Firm age	715	30.89	17.30	0.04	0.20*	0.28*	0.17*	0.10*	0.08*	0.30*	0.55*						
10. Firm size	715	7.61	1.66	0.16*	0.15*	0.75*	0.42*	0.34*	0.24*	0.33*	0.87*	0.51*					
11. Profitability	715	0.14	0.07	0.16*	0.06	0.07	0.07	0.08*	-0.05	0.01	0.22*	0.10*	0.13*				
12. Capital intensity	715	0.04	0.03	-0.04	0.05	-0.09*	-0.08*	-0.08*	0.00	0.00	0.13*	0.05	0.08*	0.34*			
13. Financial leverage	715	0.16	0.13	-0.07	0.06	0.09*	-0.12*	-0.14*	-0.04	0.08*	0.27*	0.21*	0.31*	-0.07	0.05		
14. Intangible assets	715	1.10	0.62	0.19*	-0.04	0.19*	0.16*	0.16*	0.07	-0.10*	0.04	-0.04	0.02	0.43*	0.05	0.07*	
15. Slack resources	715	0.20	0.34	-0.20*	0.02	0.05	-0.10*	-0.12*	-0.07	0.05	0.21*	0.17*	0.27*	-0.19*	-0.01	0.58*	-0.25*

Note: n for variables 2 to 5 deviates from 715 as data availability is restricted; *Abbreviation:* SD = Standard deviation; * $p < 0.05$

Table 4: Recovery times of companies across industry divisions

Industry	SIC-Code (2 digits)	n	% of firms that recovered within			Did not recover (%)
			12 months	24 months	36 months	
Agriculture, Forestry, Fishing, Mining	01-14	26	15.4	42.3	76.9	19.2
Construction	15-17	4	50.0	50.0	50.0	50.0
Manufacturing	20-39	510	35.1	67.5	82.4	11.4
Transportation & Public Utilities	40-49	40	20.0	52.5	67.5	17.5
Trade	50-59	35	42.9	80.0	91.4	0.0
Finance, Insurance, Real Estate	60-67	7	14.3	42.9	42.9	57.1
Services	70-89	91	48.4	72.5	84.6	8.8
Public Administration	91-99	2	0	50.0	50.0	50.0
Total	--	715	--	--	--	--
Average	--	--	35.4	66.6	81.4	11.9

Note: We classified a firm's stock as "Did not recover" if it did not reach its pre-crisis level within the 60 months (5-year) observation window. Percent missing up to 100 recovered between > 36 and <= 60 months.

Main results

We report results from our OLS regression, two-stage-least-squares (2SLS) model, and Cox survival analysis in Tables 5 to 8; the tables' structure is alike. First, we ran our models with controls only. Second, we added the independent variable of interest. Last, we included interaction terms. We coded variables such that a positive coefficient indicates a positive contribution to organizational resilience. For our severity of loss analysis, a positive coefficient indicates a softer (i.e., less severe) stock price drop and hence higher stability. For our time to recovery analysis, a positive coefficient indicates a higher chance of recovery and therefore higher flexibility. In our survival model output (Tables 7 and 8), we report coefficients rather than hazard ratios. The hazard ratio represents the change in probability of recovery when the respective variable increases by one unit; it does, however, not convey information about much faster this recovery occurs. A hazard ratio can be obtained by exponentiating the shown coefficient.

Analysis of post-crisis stability (severity of loss model)

Overall, we can confirm hypothesis 1a, which states that pre-crisis innovation positively impacts organizational stability once a systemic shock sets in. However, statistical significance and effect sizes are not consistent across all innovation measures. In contrast, we cannot confirm hypothesis 2a, which states that the association between pre-crisis innovation and organizational stability is stronger when pre-crisis firm-level profitability is low.

Results from our regular OLS regression presented in Table 5, Column 2 indicate that innovation input - quantity softens the stock price drop ($B = 0.04$, $p < 0.01$). We verified our results with an instrumental regression to encounter endogeneity concerns. Table 2 displays the first-stage regression results that allow us to predict innovation input - quantity with three instruments and the standard set of control variables. The instruments, i.e., index count ($B = 0.05$, $p < 0.05$), index presence ($B = 0.07$, $p < 0.001$) and no. of employees ($B = -0.38$, $p < 0.001$), together with ten controls explain 79% of the variance found in the independent variable (i.e., innovation input - quantity). Table 5, Column 4, presents the results from the second stage of the 2SLS regression. We can again strongly confirm prior findings: innovation input - quantity ($B = 0.17$, $p < 0.001$) softens crisis-triggered stock price losses. Focusing on innovation output measures, we receive contrasting results: neither innovation output - quantity nor innovation output - quality influences severity of loss because coefficients are statistically not different from zero (Table 6, Columns 2 and 5).

Rerunning the OLS and 2SLS regressions with profitability as a moderator does not alter the results above. The respective coefficients for the interaction terms are statistically insignificant (Table 5, Columns 3 and 5; Table 6, Columns 3 and 6).

In summary, we find sustainable support for hypothesis 1a in the innovation input - quantity measure but not in the innovation output measures. Further, we cannot confirm hypothesis 2a - neither for innovation input nor output measures.

Table 5: Regressions results for the analysis of post-crisis stability (severity of loss) and focus on innovation input - quantity

Variable	Dependent variable: severity of loss				
	(1) Controls	(2) OLS	(3) OLS, Moderated	(4) 2SLS	(5) 2SLS, Moderated
Innov. input - quantity		0.04**	0.04**	0.17***	0.17**
		(0.01)	(0.01)	(0.05)	(0.06)
Innov. input - quantity:profit.			-0.01		-0.01
			(0.01)		(0.06)
Firm age	-0.01	-0.01	-0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Firm size	0.03***	-0.00	-0.00	-0.13**	-0.13**
	(0.01)	(0.01)	(0.01)	(0.04)	(0.05)
Profitability	0.03**	0.03***	0.03***	0.04***	0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Capital intensity	-0.02**	-0.02**	-0.02**	-0.02*	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Financial leverage	-0.01	-0.01	-0.01	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Intangible assets	0.01	-0.00	-0.00	-0.02*	-0.02*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Slack resources	-0.03	-0.03*	-0.03*	-0.03**	-0.03**
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)
Pre-crisis stock price	0.02	0.02*	0.02*	0.03*	0.03*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	-0.03	-0.05	-0.05	-0.16*	-0.16*
	(0.05)	(0.05)	(0.05)	(0.07)	(0.07)
Industry dummies	Included	Included	Included	Included	Included
Year-month dummies	Included	Included	Included	Included	Included
Observations	547	547	547	547	547
Adjusted R^2	0.40	0.41	0.41	0.29	0.28
Wald test X^2	--	--	--	6.47***	6.34***
F statistic	7.60***	7.70***	7.61***	--	--

Note: Values are presented as B (SE) unless noted otherwise; standard errors are robust; numeric variables have been centered and standardized; coefficients and standard errors displayed as 0.00 are not exactly equal to zero but only < 0.005; *** p < 0.001, ** p < 0.01, * p < 0.05

Table 6: Regressions results for analysis of post-crisis stability (severity of loss) and focus on innovation output

Variable	Dependent variable: severity of loss					
	(1) Controls	(2) OLS	(3) OLS, Moderated	(4) Controls	(5) OLS	(6) OLS, Moderated
Innov. output - quantity		0.00	0.00			
		(0.01)	(0.01)			
Innov. output - quantity:profit.			0.00			
			(0.01)			
Innov. output - quality					0.00	0.00
					(0.01)	(0.01)
Innov. output - quality:profit.						-0.00
						(0.01)
Firm age	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Firm size	0.03***	0.03**	0.03**	0.03***	0.03**	0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Profitability	0.02**	0.02**	0.02**	0.02**	0.02**	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Capital intensity	-0.02*	-0.02*	-0.02*	-0.02**	-0.02**	-0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Financial leverage	-0.01	-0.00	-0.00	-0.01	-0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Intangible assets	0.01	0.01	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Slack resources	-0.03	-0.03*	-0.03	-0.03	-0.03	-0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Pre-crisis stock price	0.02*	0.02*	0.02*	0.02*	0.02*	0.02*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Industry dummies	Included	Included	Included	Included	Included	Included
Year-month dummies	Included	Included	Included	Included	Included	Included
Observations	660	660	660	646	646	646
Adjusted R^2	0.42	0.42	0.42	0.42	0.42	0.42
F statistic	7.71***	7.60***	7.49***	7.59***	7.47***	7.36***

Note: Values are presented as B (SE) unless noted otherwise; standard errors are robust; numeric variables have been centered and standardized; coefficients and standard errors displayed as 0.00 are not exactly equal to zero but only < 0.005; *** p < 0.001, ** p < 0.01, * p < 0.05

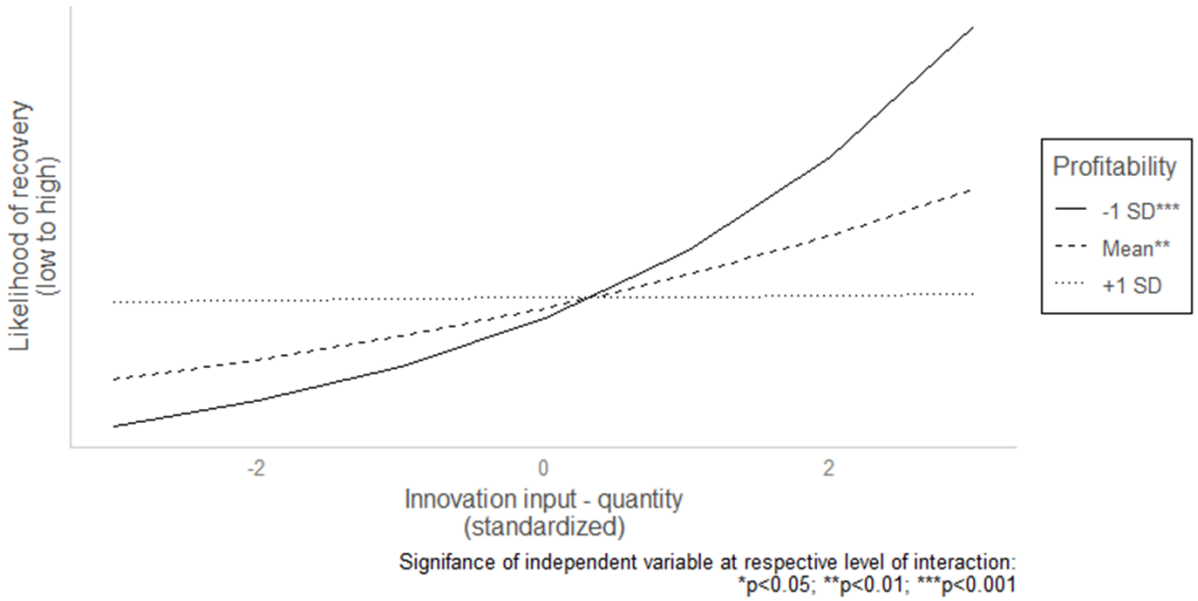
Analysis of post-crisis flexibility (time to recovery model)

Overall, we can confirm hypotheses 1b and 2b, even though we need to acknowledge that effect significance and size are not consistent across all three independent variables and partly depend on a firm's profitability level. Hypothesis 1b states that pre-crisis innovation positively impacts organizational flexibility once a systemic shock sets in. Hypothesis 2b states that associations between pre-crisis innovation and organizational flexibility are stronger when pre-crisis firm-level profitability is low.

Standardized results from our survival analysis are presented in Table 7 and distinguish between innovation input and output as well as between quantity and quality. Firms with greater pre-crisis innovation input - quantity (Table 7, Column 2) are more likely to recover faster ($B = 0.13$, $p < 0.05$). More specifically, a one standard deviation increase in innovation input - quantity increases the likelihood of recovery by 13.9% [exp(0.13) – 1 * 100%]. For our innovation output measures, we do not receive statistically significant effects at the overall level (quantity: $B = 0.05$, $p > 0.05$; quality: $B = -0.03$, $p > 0.05$; Table 7, Columns 5 and 8). With innovation input - quantity having a positive impact on chances of firm recovery, we see a positive contribution towards organizational flexibility and therefore support for hypothesis 1b. Innovation output measures do, in contrast, not confirm hypothesis 1b.

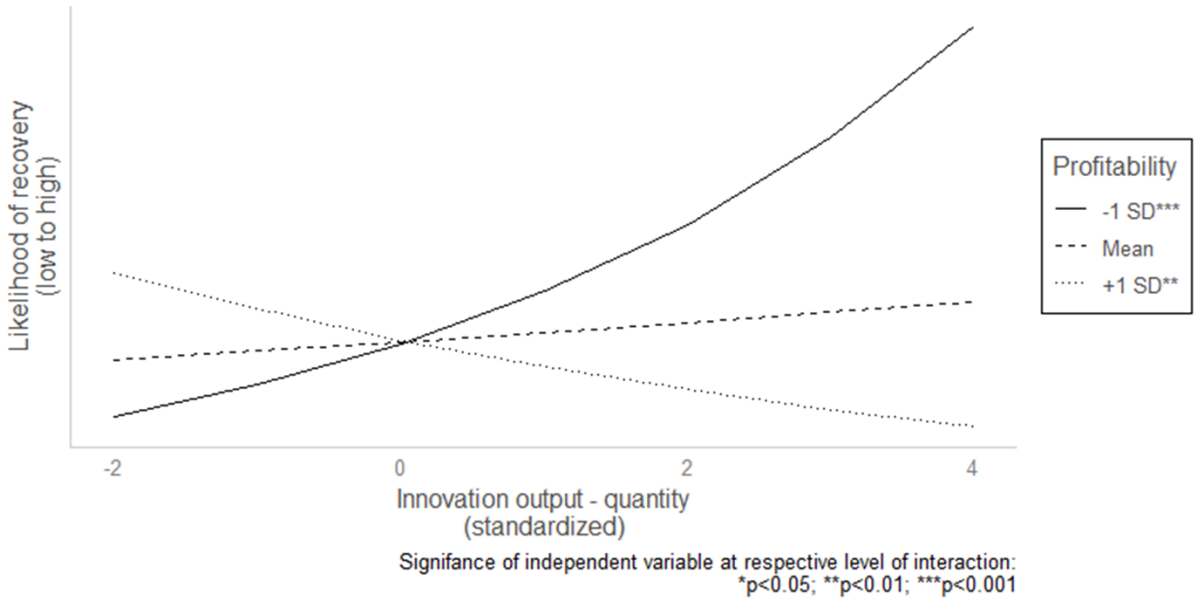
Next, we ran our statistical model with firm profitability as a moderator to evaluate hypothesis 2b. We find consistent interaction effects across all three independent variables ($-0.24 \leq B \leq 0.16$, $0.001 < p < 0.01$; Table 7, Columns 3, 6 and 9). The interaction coefficients' negative algebraic sign indicates that the combined effect of the independent variable and the moderator is less than the simple sum of the individual effects. Across all models, our results show that a stepwise, one standard deviation increase in profitability reduces the positive impact our innovation measures have on the likelihood of recovery (Figures 3 to 5).

Figure 3: Joint effect of innovation input - quantity and profitability on likelihood of recovery



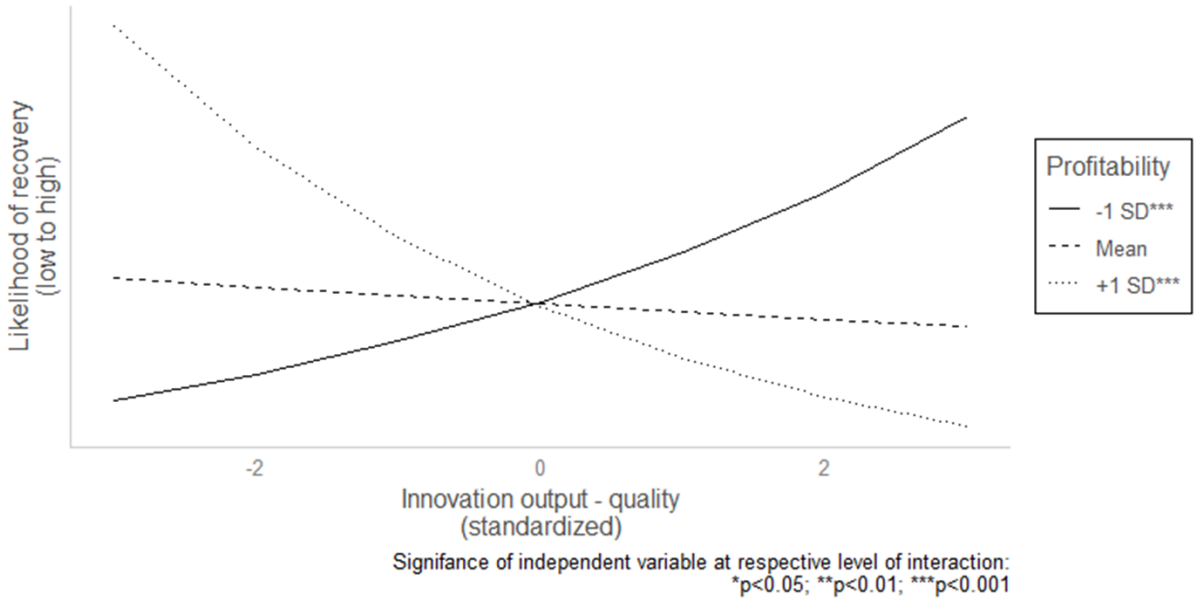
Source: own illustration

Figure 4: Joint effect of innovation output - quantity and profitability on likelihood of recovery



Source: own illustration

Figure 5: Joint effect of innovation output - quality and profitability on likelihood of recovery



Source: own illustration

More precisely, firms with under-average profitability (profitability: -1 SD) recover significantly faster if they showed strong, pre-crisis innovation input - quantity (Table 8, Column 1; Figure 3). Expressed mathematically, these firms have a 39.1% [exp(0.33) – 1 * 100%] higher likelihood of recovery if they managed to increase their innovation input - quantity by one standard deviation in the pre-crisis period. Firms with only average profitability still benefit from an 18.5% [exp(0.17) – 1 * 100%] higher probability of recovery (Table 8, Column 2; Figure 3), while highly profitable firms do not profit from higher recovery chances if their innovation input - quantity measure was high (B = 0.01, p > 0.05; Table 8, Column 3; Figure 3).

Interaction effects for innovation output - quantity and innovation output - quality are similar in nature but differ from our findings for innovation input - quantity. Again, we find negative interaction coefficients (Table 7, Columns 6 and 9) but notice the statistical insignificance of both independent variables (innovation output - quantity and quality) at mean profitability (Table 7, Columns 6 and 9; Table 8, columns, 5 and 8). In case firms show an under- or over-average pre-crisis profitability, an increase in innovation output quantity or quality

increases or decreases the likelihood of early firm recovery, respectively. As such, we find that firms with under-average profitability showed a 28.4% [exp(0.25) – 1 * 100%] higher probability of recovery when innovation output - quantity increased by one standard deviation (Table 8, Column 4; Figure 4). Similarly, the likelihood of recovery decreases for firms with an over-average profitability (-13.1% [exp(-0.14) – 1 * 100%]; Table 8, Column 6; Figure 4). Findings for innovation output - quality are alike, except for slightly different coefficients and hazard ratios, respectively (Table 8, Columns 7 and 9; Figure 5). These results prove that a sense of urgency, observed through under-average profitability, strengthens the relationship between pre-crisis innovation and chances of recovery so that we can finally confirm hypothesis 2b.

In summary, we find sustainable support for hypothesis 1b and hypothesis 2b.

Table 7: Cox survival analysis of post-crisis flexibility (time to recovery)

Variable	Dependent variable: time to recovery								
	(1) Controls	(2) OLS	(3) OLS, Mod.	(4) Controls	(5) OLS	(6) OLS, Mod.	(7) Controls	(8) OLS	(9) OLS, Mod.
Innov. input - quantity		0.13*	0.17**						
		(0.05)	(0.05)						
Innov. input - quantity:profit.			-0.16**						
			(0.05)						
Innov. output - quantity					0.05	0.05			
					(0.05)	(0.05)			
Innov. output - quantity:profit.						-0.20***			
						(0.05)			
Innov. output - quality								-0.03	-0.03
								(0.05)	(0.05)
Innov. output - quality:profit.									-0.24***
									(0.05)
Firm age	-0.17**	-0.16**	-0.15**	-0.21***	-0.21***	-0.20***	-0.19***	-0.19***	-0.19***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Firm size	-0.00	-0.13*	-0.14*	-0.01	-0.04	-0.03	-0.04	-0.02	0.00
	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Profitability	0.05	0.06	0.05	0.03	0.03	0.01	0.02	0.02	-0.01
	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Capital intensity	-0.01	-0.00	-0.02	0.04	0.04	0.01	0.04	0.04	0.02
	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Financial leverage	-0.01	0.00	-0.01	-0.03	-0.02	-0.04	-0.02	-0.02	-0.04
	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Intangible assets	0.09*	0.07	0.08	0.14**	0.13**	0.17***	0.14**	0.14***	0.19***
	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Slack resources	0.14***	0.13***	0.11***	0.16***	0.16***	0.14***	0.15***	0.15***	0.14***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Pre-crisis stock price	-0.32***	-0.30***	-0.31***	-0.21***	-0.21***	-0.21***	-0.20**	-0.20**	-0.20**
	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Industry dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included
Year-month dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included
Observations	485	485	485	583	583	583	572	572	572
LR Test	270.4***	271.0***	276.5***	132.1***	132.4***	137.3***	152.8***	153.1***	163.2***
Score (Logrank) Test	1154.7***	1157.5***	1164.5***	1347.4***	1347.7***	1358.1**	1313.4***	1313.6***	1327.6***

Note: Values are presented as B (SE) unless noted otherwise; standard errors are robust; numeric variables have been centered and standardized; coefficients and standard errors displayed as 0.00 are not exactly equal to zero but only < 0.005; *** p < 0.001, ** p < 0.01, * p < 0.05

Table 8: Slope tests on moderator *Profitability* for analysis of post-crisis flexibility (time to recovery)

Variable	Dependent variable: time to recovery								
	(1) -1 SD	(2) Mean	(3) +1 SD	(4) -1 SD	(5) Mean	(6) +1 SD	(7) -1 SD	(8) Mean	(9) +1 SD
Innov. input - quantity	0.33***	0.17**	0.01						
	(0.05)	(0.05)	(0.05)						
Innov. input - quantity:profit.	-0.16***	-0.16**	-0.16***						
	(0.03)	(0.05)	(0.04)						
Innov. output - quantity				0.25***	0.05	-0.14**			
				(0.05)	(0.05)	(0.05)			
Innov. output - quantity:profit.				-0.20***	-0.20***	-0.20***			
				(0.03)	(0.05)	(0.04)			
Innov. output - quality							0.21***	-0.03	-0.27***
							(0.05)	(0.05)	(0.05)
Innov. output - quality:profit.							-0.24***	-0.24***	-0.24***
							(0.03)	(0.05)	(0.04)
Firm age	-0.15**	-0.15**	-0.15**	-0.20***	-0.20***	-0.20***	-0.19***	-0.19***	-0.19***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Firm size	-0.14*	-0.14*	-0.14*	-0.03	-0.03	-0.03	0.00	0.00	0.00
	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Profitability	0.05	0.05	0.05	0.01	0.01	0.01	-0.01	-0.01	-0.01
	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Capital intensity	-0.02	-0.02	-0.02	0.01	0.01	0.01	0.02	0.02	0.02
	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Financial leverage	-0.01	-0.01	-0.01	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Intangible assets	0.08	0.08	0.08	0.17***	0.17***	0.17***	0.19***	0.19***	0.19***
	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Slack resources	0.11***	0.11***	0.11***	0.14***	0.14***	0.14***	0.14***	0.14***	0.14***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Pre-crisis stock price	-0.31***	-0.31***	-0.31***	-0.21***	-0.21***	-0.21***	-0.20**	-0.20**	-0.20**
	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Industry dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included
Year-month dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included
Observations	485	485	485	583	583	583	572	572	572
LR Test	276.5***	276.5***	276.5***	137.3***	137.3***	137.3***	163.2***	163.2***	163.2***
Score (Logrank) Test	1164.5***	1164.5***	1164.5***	1358.1***	1358.1***	1358.1***	1327.6***	1327.6***	1327.6***

Note: Values are presented as B (SE) unless noted otherwise; standard errors are robust; numeric variables have been centered and standardized; coefficients and standard errors displayed as 0.00 are not exactly equal to zero but only < 0.005; *** p < 0.001, ** p < 0.01, * p < 0.05

Main findings and theoretical backing

Our statistical analysis reveals that confirmation or denial of our hypotheses is contingent on the selection of the dependent and inclusion of the moderator variable (Table 9). If we took a relaxed approach and did not differentiate between variable selection and inclusion, we could directly find support for all but one hypothesis. However, we see value in examining the non-uniform results in greater detail by providing additional reasoning for each dependent variable and hypothesis.

Table 9: Overview of confirmed and not confirmed hypotheses

Focus variable	H1a	H1b	H2a	H2b
Innovation input - quantity	confirmed	confirmed	--	confirmed
Innovation output - quantity	--	--	--	confirmed
Innovation output - quality	--	--	--	confirmed

Note: hypotheses that could not be confirmed statistically are marked as "--"

We find support for H1a in the innovation input - quantity variable only. As argued before, organizational stability is short-term oriented, carries an operational component, and requires a company to remain intact despite environmental change (Weick et al., 1999). The necessary actions to remain organizationally stable resemble those practiced in the innovation process and are thus captured in the innovation input - quantity measure. In contrast, the economic benefits captured in the innovation output measures require time to unfold – also because economic benefits have a strong strategic rather than operational character. As such, it appears reasonable to see innovation output measures not influencing organizational stability.

We do not find any support for H2a. We attribute the absence of a statistically significant effect to the thought that low profitability and hence a high sense of urgency lead to a strategic, long-term change whose benefit does not contribute to maintaining day-to-day operations.

We find support for H1b in the innovation input - quantity variable only. As described earlier on, organizational flexibility is mid- to long-term oriented and covers the path of

recovery. We extensively expanded on the procedural benefits of innovation earlier on and therefore expected the influence of innovation input - quantity. We were, however, surprised by the non-significance of the innovation output variables. Given the match between both variables in their long-term orientation and innovation output's economic contribution to business recovery, interdependencies appeared to be logical. Therefore, we investigated further and reconsidered the patent-based operationalization of the innovation output variables. The pure possession of (high-quality) patents is not beneficial by itself because the intrinsic economic value remains dormant until activation, i.e., transformation into a marketable product or service. As such, we found theoretical evidence that economic underperformance triggers strategic change, which in turn urges management to adjust the firm's innovation strategy (Haleblian & Rajagopalan, 2005; Kirtley & O'Mahony, 2020; Tushman et al., 1986; Yu et al., 2019). In consequence, we introduced the moderation of profitability, interpreted as sense of urgency.

We find support for H2b in all three independent ~~dependent~~ [corrected on 20.12.2022 by original author] variables, i.e., innovation input - quantity, innovation output - quantity, and innovation output - quality. Hypothesis 2b builds on the contingency of sense of urgency, which acts as a trigger or booster to turn dormant innovation stock into economic value. As such, we found that firms whose profitability was low in the pre-crisis period were able to better extract value from their innovation output than firms that did not experience this pressure. We interpret this insight as a "crisis in a crisis". Firms that experienced difficulties before the main, i.e., systemic, crisis set in, were already in a crisis management mode and presumably established task forces and developed actions to regain economic strength. In contrast, firms that belonged to the group of average or even over-average performing organizations were probably as staggered by the systemic shock as their underperforming peers were, but they were instead caught flat-footed. Therefore, we conclude that firms that were already fighting for better performance could integrate measures to mitigate the systemic shock more easily than those which focused on other than crisis-related topics.

We underline our findings with established theories and particularly create links between the procedural benefits of innovation and organizational resilience. First, we consider the resource-advantage theory (Hunt & Morgan, 1995). The authors suggest that firms develop a sustainable, competitive advantage by retaining resources and structuring, bundling, and leveraging these assets (Hult, 2011). Most importantly, Hunt and Morgan (1995) complete the traditional, neoclassical set of inputs, i.e., land, labor, and capital, by intangible resources such as organizational culture, knowledge, competencies, and relationships. These are expected to have significant relevance for modern companies in less natural resources-based industries. In addition, they assign a holistic set of roles to the management team. Rather than only determining production quantity and implementing production function, as suggested by neoclassical theory, Hunt and Morgan (1995) attribute much broader responsibility to the leadership team, i.e., recognizing, understanding, creating, selecting, implementing, and modifying the corporate strategy. As such, the resource-advantage theory expects that firms with a more valuable set of resources and a proactive management team are better positioned in the marketplace (Hunt & Morgan, 1995). Building on the theory of Hunt and Morgan (1995), we see strong commonalities between their extended list of essential resources and the procedural benefits of innovation on the one hand, and between management's responsibility to take care of strategic change and the performance-triggered sense of urgency on the other hand. As such, we can theoretically back our findings that pre-crisis innovation strengthens competitive advantage and thus contributes to organizational resilience in times of distress. In addition, we find theoretic support that a high, performance-triggered sense of urgency pushes a firm's management team to take strategic action.

Second, we consider the social network theory in the context of organizations (Granovetter, 1973; Thorelli, 1986). Network theory explains the relationships and dynamics among individuals through actors, resource ties, and activity links (Hakansson, 2015). In light of the network theory, the term "resources" is widely defined and includes, among others, input

goods, financial and human capital, as well as technology and innovation. Granovetter (1973) differentiates between strong and weak ties and defines the strength of a tie by its "combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services" (Granovetter, 1973: 1361). Creating a link between network theory and economic performance, Granovetter argues that it is most notably the combination of strong and weak resource ties that lead to overall success within the network (Granovetter, Harvard University Press, 1974; Hult, 2011). Building on the findings of Granovetter (1973), we see strong commonalities between the described mechanics of his network theory and the procedural benefits of innovation. As such, we match the theory's term "activities" to all actions that are part of the innovation process (Figure 1, Geissdoerfer et al., 2016). We further recognize the theory's term "actors" as all individuals and departments that are part of the innovation process; these typically include both primary (i.e., operations, marketing, after-sales) and supporting functions (HR, strategy, R&D). In sum, we conclude that intra-firm networks consisting of strong and weak ties among actors are established through the innovation process itself. As such, the network theory underlines that such networks improve performance – expressed as stronger organizational stability and flexibility in specific, and higher organizational resilience in general.

Diagnostic and robustness tests

We ran a battery of tests to check our results for robustness and can eventually confirm that our findings hold under different settings.

We describe the robustness tests for the post-crisis stability model (severity of loss) in appendix E and summarize the overarching results as follows. Altering the observation periods of the dependent and independent variables does – apart from slightly weaker statistical effects for shorter time periods for select measures – not lead to major differences. Further, we retrieve highly comparable results when varying the number, selection, and calculation of our control

variables. Lastly, we tested for linearity, constant error variance, independent error terms, multicollinearity, and endogeneity and can confirm that the key assumptions for OLS models hold.

Similarly, we describe the robustness tests for the post-crisis flexibility model (time to recovery) in appendix F and summarize the overarching results as follows. We confirmed the proportional hazard assumption by visual and statistical inspection. Altering observation periods of dependent and independent variables does not affect our findings. By re-running our analysis on subsamples, we can confirm the consistency of coefficients and significances.

Overall, we can confirm that our results remain stable even if we change key parameters and can hence corroborate our findings.

DISCUSSION

By applying our research model to a systemic crisis, we find that a strategic emphasis on innovation does influence organizational resilience in adverse situations. By pursuing innovation activities and by transforming existing innovation assets into process improvements or marketable products, companies become more stable and flexible such that crisis-related losses are mitigated.

Research-related implications

We contribute to research at the interface of crisis management, innovation, and strategic change in three ways. First, we enrich the research stream that describes the comprehensive relationship between innovation and firm performance (Rust, Ambler, Carpenter, Kumar, & Srivastava, 2004; Srinivasan, Pauwels, Koen, Silva-Risso, Jorge, & Hanssens, 2004; Tellis, 2004). While existing work extensively discusses how innovation affects a firm's market position, financial position, or stock price performance through various measures (Pauwels, Silva-Risso, Srinivasan, & Hanssens, 2004; Rubera & Kirca, 2012; Sorescu & Spanjol, 2008; Srinivasan et al., 2004), our study is one of the few which relates innovation to adverse situations. In difference to Archibugi et al. (2013b), who observed firms' innovation strategy during the crisis, we strictly measure pre-crisis innovation and extend Devece et al. (2016) findings that benefits of an innovation focus particularly unfold during periods of recessions. Since we empirically showed that a strategic emphasis on innovation softens the negative consequences of a systemic shock, we establish pre-crisis innovation to have an insurance-like character.

Second, we expand the research on antecedents of organizational resilience. While existing research related organizational resilience predominantly to psychological stability on the employee level (Coutu, 2002; Luthans, 2002a, 2002b), to supply chain robustness in day-to-day operations (Christopher & Peck, 2004; Paul & Saad, 2021; Ponomarov & Holcomb, 2009; Raj Sinha et al., 2004; Rice & Caniato, 2003; Sodhi & Tang, 2012), to a firm's business model

(Gittell et al., 2006; Hamel & Välikangas, 2003; Vogus & Sutcliffe, 2007), and most recently to stakeholder relationships (DesJardine et al., 2019; Sajko et al., 2020), we are among the first who move innovation into core focus. Our research fits a call for papers on crisis management (Kronberger, Meyer, Frey-Heger, Gatzweiler, & Marti, 2021) and responds to the invitation to contribute research focusing on collective action within an organization to mitigate crisis-related effects.

Third, we disaggregate the overall positive effects of innovation on organizational resilience by introducing a contingency factor. Thereby, we inform existing literature on crisis management that a strategic emphasis on innovation is even more beneficial under certain conditions. We empirically validated that firms in an urgency mode, proxied through under-average performance in the pre-crisis period, can leverage their pre-crisis innovation efforts even stronger to mitigate losses triggered through adverse situations. As such, we directly respond to Linnenluecke (2017), who strongly suggests investigating additional sources, capacities, and mechanics that lead to organizational resilience.

Managerial implications

Our results suggest that CxOs are not at the mercy of a systemic crisis but can instead actively soften crisis-related losses. In addition to extensively discussed measures that are essential and beneficial during the crisis (Linnenluecke, 2017), leadership teams can provide for the future by taking preventive action. As such, we put forward three recommendations. First, we advise leadership teams to strategically consider innovation as a booster for organizational resilience. Since we found that both economic and procedural benefits of innovation increase stability and flexibility, leadership teams should carefully control the underlying mechanics. To reap economic benefits, we suggest that the management team pushes for a high-quality, well-filled process improvement and product pipeline. To realize procedural benefits, we recommend that the management team establishes an environment of exchange and trust among all employees.

Second, we specifically remind leadership teams of well-performing companies to strive for constant renewal and optimization of their (innovation) strategy. Since we found that firms with a high sense of urgency, i.e., under-average pre-crisis profitability, and a consequential adjustment of their innovation strategy were better able to reap the benefits of pre-crisis innovation, we put forward that well-performing companies need to be specifically attentive to strategic adjustments to mitigate crisis-related losses – predominantly for the reason that no external pressure urges them to change.

Third, we encourage leadership teams to balance the different alternatives to achieve higher levels of organizational resilience. Concluding this paper, we found that, among others, psychological (e.g., Coutu, 2002), operational (e.g., Christopher & Peck, 2004), corporate social responsibility (e.g., DesJardine et al., 2019), and innovation-related means contribute to organizational stability and flexibility in times of distress. Rather than stubbornly engaging in all or any preventive activities, we advise leadership teams to carefully select combinations that best fit their firm's business model in the first place and contribute to organizational resilience only in the second place. This prioritization acknowledges that the timing, severity, and character of systemic crises remain unpredictable. Accordingly, leadership teams should predominantly steer decisions and efforts to remain successful in their business and should reap additional resilience-building benefits where reasonable. As such, we have just proved that innovation serves as one out of several options.

Limitations and avenues for future research

This paper has specific limitations that can motivate future research at the interface of crisis management, organizational resilience, and innovation. As Brand and Jax (2007) outlined, organizational resilience is a theoretic concept whose level of achievement cannot be observed and measured directly. Even though we are convinced of the established operationalization, which differentiates between the characteristics of stability and flexibility (DesJardine et al.,

2019; Sajko et al., 2020), we see value in defining and applying alternative concepts. As such, researchers could look deeper into the process of adaptation which is particularly valuable if a crisis changes the business environment permanently.

We see further limitations in our dependent and independent variables. We derived our dependent variables from stock price data and thus need to acknowledge some restrictions, e.g., we only consider listed firms and ignore private companies; stock price performance represents an aggregate of many factors which can only partly, but not completely, be separated by control variables; stock prices are determined by supply and demand so that a variety of non-distinguishable motives influence investors to buy or sell shares. While established literature considers "stock prices [to be] among the best measures available to assess resilience in general crises" (DesJardine et al., 2019: 1457), we recommend that researchers evaluate alternative variables, e.g., qualitative measures (Linnenluecke, 2017). In addition, we determine our independent variables through R&D expense and patent data and thus need to acknowledge some restrictions, e.g., we neglect innovation activities that are not captured through financial or patent-based information; we do not consider the reasons which motivate firms to develop, register or even acquire patents; we only acknowledge patents that are registered with the USPTO and hence ignore intellectual property only recorded in other jurisdictions, e.g., Europe or Asia. Consequently, we advise future researchers to take a broader perspective on a firm's innovation activities and imagine that qualitative sources lead to alternative, maybe even superior measures.

CONCLUSION

Our research shows that the interaction between organizational resilience and innovation is not a linear, one-dimensional relationship. We successfully confirmed that CxOs can mitigate crisis-related losses through a strategic emphasis on innovation. Both economic and procedural benefits of innovation activities help firms to remain organizationally stable and flexible. We proved that the positive associations are even stronger if leadership teams shift to an innovation-centered focus before the systemic crisis's onset. Our findings base on the resource-advantage and social network theory and extend the literature at the interface of crisis management, innovation, and strategic change. Given that our study is one of the few investigating the resilience-innovation relationship, we firmly advise fellow researchers to expand on the characteristics of organizational resilience and apply a more holistic approach to measure innovation.

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APPENDICES

Appendix A: Unique features constitute the GFC an ideal setting for our analysis

We consider the GFC an ideal setting for testing our hypotheses for several reasons. First, up until then, the GFC was unprecedented in its duration and depth as it lasted about 18 months, triggered a 6% U.S. GDP decline, and doubled the long-term, historical-high unemployment rate (Kalleberg & Wachter, 2017; Song & Wachter, 2014). Second, even though the GFC originated in the U.S., it eventually impacted economies, governments, corporations, and private households across the globe, irrespective of wealth, size, and industry focus. Third, while in retrospect, several indicators hinted toward a crisis, its actual outbreak and timing were mostly unexpected (Lin & Treichel, 2012). As such, we can reasonably assume that organizations could not initiate dedicated mitigating measures a priori but could only rely on their general crisis management assets – may it be skills, procedures, or knowledge. Lastly, as the GFC officially ended in June 2009, we can adequately apply our models to both the crisis's core and recovery period. Hence, due to all the crisis's severity, its wide-ranging global and industry-agnostic impact, its unpredictability as well as the extended modeling period, the 2008 GFC forms an optimal research basis for examining the relationship between innovation and organizational resilience.

Appendix B: Investigations on a potential R&D sample selection bias

First, we need to acknowledge that not all companies' business models require research and development. As such, our data set contains R&D expense figures for 77% of manufacturing companies while, in contrast, R&D data availability for firms with a transportation & utility, trade, finance, and service focus is below 10%. Prior work confirms a differentiation of R&D relevance by sectors (Grassano, Hernandez Guevara, Tuebke, Amoroso, Dosso, Mafini, Georgakaki, Aliki, & Pasimeni, 2020; Hirsch-Kreinsen, Jacobson, & Robertson, 2006). Second, as disclosing research and development expenses is compulsory for U.S. companies (Bogle,

2019), we assume that renowned databases systematically record R&D figures if such investments incur. Third, even if companies had legal options to control R&D expense publication for opportunistic reasons, Hall and Oriani (2006) found that "no sample selection bias [is] induced by the choice of firms not to disclose their R&D expenditures" (Sandner & Block, 2011: 976). Last, we ran an ANOVA to evaluate whether differences in the means of our dependent variables between the two groups of companies, i.e., those with versus those without R&D data, are substantial. The results show that such variances are either small or statistically insignificant. To summarize, the above validations and cross-checks do not provide evidence that missing R&D data in our sample is systematic.

Appendix C: Pursued steps to match Compustat and USPTO data

First, we linked Compustat and USPTO data with a publicly available crosswalk created and maintained by Kogan et al. (2017). This table matches USPTO's patent number to WRDS's PERMNO and PERMCO used in Compustat and CRSP databases. Second, we manually verified 10% of our sample companies by comparing the matched patent assignee IDs with the company names on USPTO's online patent database. Deviations were minor and strengthened our assumption that the crosswalk operates correctly. Third, we repeated the checks already pursued for verifying our R&D data results. As such, our sample records patent data for 82% of our manufacturing firms, but also notable shares for service (44%), transportation & utility (32%), trade (21%), and finance (14%) oriented companies. We finally ran an ANOVA to compare the means of our dependent variables by group, i.e., firms with versus firms without patent data; the resulting differences are statistically not significant. To summarize, the above validations and cross-checks do not provide evidence that the patent matching process led to systematic errors.

Appendix D: Addressing endogeneity in OLS regressions through instrumental analysis

One concern of OLS regressions is endogeneity, which refers to the undesired setting that an independent variable correlates with the error term, eventually leading to invalid OLS estimates. For example, one could argue that firms that survived several crises prior to the GFC invested more in innovation due to their better financial performance. A second concern is the omitted variable bias, which occurs when OLS models leave out confounders that simultaneously affect dependent and independent variables. For example, one could argue that firms with a strong and visionary top management team invest more in innovation and perform better in adverse environments. To mitigate endogeneity concerns, we performed a 2SLS regression with instrumental variables. Statistical results underline the application of a 2SLS regression.

We conducted a Durbin-Wu-Hausman test for innovation input - quantity to check for the presence of endogeneity in our OLS model with severity of loss as the dependent variable. The null hypothesis states that the independent variable is exogenous, i.e., that there is no correlation between innovation input - quantity and the regression's error term. As test results refuted the null hypothesis ($F = 11.18$, $p < 0.001$), we acknowledge that endogeneity is a concern and strongly recommend using instrumental variables. Next, we performed several tests to check the validity of the three instrumental variables, i.e., index count, index presence, and number of employees. We present results from the first stage regression and validity checks in Table 2.

We tested whether our instruments correlate with the error term using the Sargan test, which is alternatively called "Test for overidentifying restrictions". The null hypothesis states that the covariance between our instruments and the main regression's error term is zero. As test results for innovation input - quantity rejected the null hypothesis ($F = 3.55$, $p = 0.17$), we acknowledge that our instruments are not directly correlated with our dependent variable, i.e., severity of loss. We further tested whether our instruments are weak, which means that their "correlation with the endogenous regressors, conditional on any controls, is close to zero"

(Andrews, Stock, & Sun, 2019: 727–728). The null hypothesis under the Cragg-Donald test states that the instrumental variables are weakly identified (i.e., all index count, index presence, and number of employees are weak predictors for innovation input - quantity). Our Cragg-Donald test results (F = 17.14) exceeded the Stock-Yogo critical values at the 30% (5.39), 20% (6.46), 10% (9.08) and 5% (13.91) maximal instrumental relative variable bias levels. The respective maximal instrumental variable size lies between 15% (12.83) and 10% (22.30) (Stock & Yogo, 2005). As such, we rejected the null hypothesis. To summarize, based on the instrumental variables validity tests, we can confirm that our three instrumental variables are reasonable predictors of innovation input - quantity and that an inclusion makes our analysis more meaningful.

Appendix E: Robustness tests for the post-crisis stability model (severity of loss)

First, we altered the length of observation windows for both the dependent and independent variables. In addition to the default 12 months observation period for the severity of loss variable, we checked regression results for a time span of 18, 24, and 36 months and could not find any major differences. Altering the default 5-year pre-crisis observation period for our independent and control variables to 1, 3, and 10 years we found that statistical effects become partly weaker for shorter observation periods (1 year) and stronger for longer observation periods (10 years). These findings match the idea that innovation efforts yield mid- to long-term benefits rather than short-term advantages. Second, we pursued adjustments to the set of control variables, i.e., measuring firm size based on sales instead of assets, measuring profitability as EBITDA over sales instead of assets, removing select control variables (e.g., firm age, firm size, pre-crisis stock price), and received highly comparable results. Third, we pursued the standard checks for OLS model assumptions and can state that all hold. We confirmed linearity, constant error variance (homoscedasticity), and independent error terms by inspecting residual plots. We double-checked the latter by a series of Durbin-Watson (DW) tests, all yielding DW coefficients

at around 2.09 ($p > 0.85$). Consequently, we accepted the Durbin-Watson test's null hypothesis that the autocorrelation of disturbances is equal to zero and hence not a concern. We confirmed the normality of errors by checking QQ-Plots. We further ran a set of tests to check for multi-collinearity, especially since select correlations between some variables are noticeably high. Variance inflation factors (VIF) [calculated as GVIF^(1/(2*Df)] for the variables in each model are well below the established threshold of two, except for innovation input - quality and firm size in the instrumented models shown in Table 5, Columns 4 and 5. VIFs for these two variables increased to values of up to 6.1. We addressed these potential concerns by removing firm size from the regression model and still see statistical significance for innovation input - quality at the $p < 0.05$ level while respective VIFs fell to the acceptable level of < 2.3. We also investigated condition numbers, which turned out to be lower than the established threshold of 30 but also below the more conservative cut-off points of 10 and 5. We consider two exceptions in industry dummies as non-material. For completeness, we followed Echambadi and Hess (2007) and reran our models on smaller subsamples "to test the plausibility and stability of coefficients [as] unstable coefficients across these random subsets of data may confirm the presence of collinearity problems" (Echambadi & Hess, 2007: 444). Since coefficients' algebraic signs remained stable and coefficient sizes only changed marginally, we assume that the presented results are reliable. To conclude, we did not find any material indication that our models suffer from multicollinearity. We already covered the topic of endogeneity by extending our simple OLS regression with an instrumental model as described earlier.

Appendix F: Robustness tests for the post-crisis flexibility model (time to recovery)

A central assumption of Cox survival models is that regression coefficients, and thus hazard ratios, are constant, i.e., proportional over time. If the proportional hazard assumption holds, we can be certain that the relationship between our innovation measures and the time to recovery is not influenced by the time at which other adverse events might have occurred. To verify

this precondition, we pursued two tests. First, we visually inspected Schoenfeld residual plots for each independent variable and did not find any indication that the proportional hazard assumption was violated. These findings are consistent for various residual types, such as martingale, score, df beta, scaledsch, and partial residuals. Second, we ran statistical tests to underline hazard proportionality by evaluating the correlation between regression residuals and survival time. The null hypothesis states a correlation of zero. Results indicate that none of the variables of interest violate the proportional hazard assumption as respective p-values are well above the established 0.05 threshold (innovation input - quantity: $p = 0.20$, profitability: $p = 0.07$, interaction term: $p = 0.14$; innovation output - quantity: $p = 0.49$, profitability: $p = 0.13$, interaction term: $p = 0.94$; innovation output - quality: $p = 0.81$, profitability: $p = 0.08$, interaction term: $p = 0.92$). Hence, we conclude that the proportional hazard ratio assumption holds for our results.

Next, we repeated the checks already pursued for our severity of loss model. Altering the observation windows of dependent and independent variables to 18, 24, 36 months, and 1, 3, 10 years respectively, did generally not affect our results. The only notable exception are non-significances of innovation input - quantity coefficients when measured over the 10-year, pre-crisis period. Altering control variables in the same way as we did for the robustness check of our severity of loss model did not lead to any major differences in results. We further ran the survival models on sample subsets to check for the consistency of coefficients and significances (Echambadi & Hess, 2007). Again, we see a high degree of reliability in our results as subsample selection hardly affects statistical output.

Research study II

EQUALIZING TANK: EMPLOY, BALANCE, AND AMPLIFY ENTREPRENEURIAL ORIENTATION TO DEVELOP CRISIS RESILIENCE

ABSTRACT

This study explores how entrepreneurial orientation (EO) contributes to crisis resilience in systemic crises. Based on the 2007 Great Financial Crisis, we empirically examine firms' cumulative abnormal returns (CAR) subject to their level of EO, operationalized through a textual analysis of annual reports. We can strongly confirm our hypothesis that EO improves crisis resilience and detect even stronger associations for companies with a debt-leveraged capital structure. Our findings are theoretically backed by the contingency theory and the human capital theory and expand the research domains of EO and crisis resilience. Managerial implications constitute that CxOs should carefully consider their EO strategy, especially if they score high on EO. We base our empirical analysis on a sample of S&P 1500 companies.

INTRODUCTION

Since March 2020, economies, companies, and individuals have been trying hard to handle the various constraints of the COVID-19 pandemic. Governments restrict travel, organize vaccination campaigns and pass laws to support the economy. In terms of length and predictability, the COVID-19 pandemic is unprecedented. As of now, the world is unable to anticipate when and how the current systemic crisis will end. Hence, the COVID-19 pandemic is a prime example, but certainly not the only reason, why management teams are practically obliged to make their organizations crisis-proof. In this study, we examine and motivate the research streams at the interface of EO and crisis resilience, thereby responding to suggestions for future research by Linnenluecke (2017) and Rauch, Wiklund, Lumpkin, and Frese (2009).

The topic of EO is widely covered in academic literature. According to Rauch et al. (2009) and Soares and Perin (2019), prior research predominantly stresses the overall positive effects EO exerts on performance (Wiklund & Shepherd, 2003). Common research topics relate to mediators, such as network effects (Stam & Elfring, 2006; Wales, Gupta, & Mousa, 2013), innovativeness (Hult, Hurley, & Knight, 2004), and learning orientation (Hakala, 2013; Wang, 2008), or moderators, such as environmental, strategic, and culture variables (Wales et al., 2013). Few researchers, however, also found negative or non-significant relationships between EO and firm performance (Renko, Carsrud, & Brännback, 2009; Slater & Narver, 2000). As such, Naldi, Nordqvist, Sjöberg, and Wiklund (2007) revealed negative correlations to performance triggered by the risk-taking dimension of EO (Soares & Perin, 2019). Tang, Tang, Marino, Zhang, and Li (2008) tested the link between EO and performance and found an inverted U-shape relationship. So did Chen and Wang (2020) and Kim and Kim (2016) when analyzing the EO-performance relationship in light of R&D alliances and the external environment, respectively.

However, to date, researchers have only sparsely examined the relationship between EO and crisis resilience. Prominent resilience literature discusses, for example, the influence of

CSR investments (DesJardine, Bansal, & Yang, 2019; Sajko, Boone, & Buyl, 2020), business models (Gittell, Cameron, Lim, & Rivas, 2006), or supply chains (Craighead, Blackhurst, Rungtusanatham, & Handfield, 2007; Pettit, Fiksel, & Croxton, 2010). Effects of EO during times of distress are so far not in focus.

Related prior research provides arguments that EO can have both positive and negative effects on crisis resilience. Several points speak in favor of a positive EO-resilience relationship. First, a high degree of EO allows for opening up new opportunities. EO firms have profound ideas for market expansion and operational process improvement (Lumpkin & Dess, 1996a). In times of distress, EO firms can implement pre-aligned concepts promptly, thereby gaining competitive advantages. Second, a high degree of EO allows for reacting more flexibly. EO firms possess the power to think creatively, deal with unknowns, respond with pragmatism, and accept a fair degree of risk (Han & Zhang, 2021). In times of distress, EO firms can use these skills to master the typically unpredictable future. Third and last, a high degree of EO allows for an attractive public image. EO firms are more appealing to customers and employees. In times of distress, these firms benefit from stable revenue streams and operational reliability (Monsen & Wayne Boss, 2009).

However, some arguments speak in favor of a negative EO-resilience relationship. First, a high degree of EO implies inordinate autonomy. Overly ambitious EO firms may ignore advice from others, rely on internal knowledge only, and disregard alternative perspectives (Kubicek, Paškvan, & Bunner, 2017; Langfred, 2004). In times of distress, these firms are prone to miss valuable input from external parties. Second, a high degree of EO implies a lavish investment strategy. Overly ambitious EO firms risk allocating resources to non-reasonable projects (Bracker & Ramaya, 2011; Srinivasan, Lilien, & Sridhar, 2011). In times of distress, these firms are prone to waste valuable cash reserves. Third, a high degree of EO implies inordinate proactivity. Overly ambitious EO firms might make decisions too quickly and without the required caution (Cangiano, Parker, & Ouyang, 2021; Wihler & Jachimowicz, 2016). In times of distress,

these firms risk to make wrong and rash choices. Hence, existing literature suggests that an entrepreneurial orientation is not exclusively positive but may display disadvantageous effects if it takes extreme levels in either direction.

We shed light on the relationship between EO and crisis resilience and further reconcile the contrasting perspectives with a moderation. Our statistical analysis suggests that the measure of financial leverage can take this moderating role. As such, we recognize the following mechanics: debt finance introduces banks as new and additional stakeholders; debt finance requires firms to critically review their cash flows and provide collaterals for capital investments; and debt finance urges management to better planning and financial commitment.

By combining the domains of EO and crisis resilience, our study contributes to academic knowledge and managerial demand. First, the need for crisis-related research can hardly be more apparent: our economy is currently amidst a global crisis with a high degree of uncertainty. Given that we cannot predict when this crisis will end and how quickly new, comparable shocks may strike, additional academic and managerial knowledge is highly valued. Second, we respond to explicit requests for research. Linnenluecke (2017: 4) summarizes that "resilience has been operationalized [and conceptualized] quite differently across studies [and that] similarities and differences among these streams have [neither] been explored" nor generalized. Moreover, we respond to Rauch et al. (2009: 781), who advise "to open up EO research to new ideas and to further examine the role of moderators." By introducing the moderation of financial leverage, we extend existing knowledge and simultaneously provide direction for future research. Third, we satisfy the need of companies who long for advice on how to behave in times of distress. An increase in the number of resilience-related publications from renowned consulting firms such as Bain, BCG, or McKinsey is only one symptom (Bain, 2021; BCG, 2021; McKinsey, 2022). Another is the companies' increased demand for experts in crisis management (Harl, 2021; Pallo, 2021).

To verify our hypotheses, we run an event study model, thereby following DesJardine et al. (2019) and Sajko et al. (2020) in their decision to use stock price data to measure crisis resilience. We determine the degree of EO according to Lumpkin and Dess; Lumpkin and Dess; Lumpkin and Dess (1996a, 1996b, 2001) and operationalize the variable through a textual analysis of the Management Discussion & Analysis (MD&A) section of companies' 2003 to 2008 annual reports.

CONCEPTUAL BACKGROUND AND HYPOTHESES

The concept of EO has been widely discussed in management literature for more than 40 years, partly because it is seen as "one of the few examples of stabilized concepts in management science" (Basso, Fayolle, & Bouchard, 2009: 313). Even though research on EO gained significant traction from 2005 onwards, the coverage of different themes remains narrow. Martens, Lacerda, Belfort, and Freitas (2016) found in their meta-research that studies primarily deal with business performance (33% of sample articles), SMEs (18%), innovation (13%), marketing (11%), and internationalization (11%). Both Rauch et al. (2009) and Soares and Perin (2019) underline the relevance of EO in academia but express that relevant research only focuses on potential mediators and moderators. Peng, Li, van Essen, and Peng (2020) compare the research streams of entrepreneurial orientation and market orientation, but again, focus on business success as the central comparison criterion.

To conclude, even though the topic of EO receives much scholarly attention, the breadth of contents remains limited. Only a few topics are intensively discussed, while others remain underresearched (Martens et al., 2016: 558). As such, we see that the relationship between EO and crisis management or crisis resilience lacks academic consideration and therefore represents a highly viable avenue for additional research.

We decided to apply the concept of EO in our study as it comprises dimensions of knowledge sharing and application (Li, Liu, Wang, Li, & Guo, 2009), innovation focus (Pérez-Luño, Wiklund, & Cabrera, 2011), decision making (Laskovaia, Marino, Shirokova, & Wales, 2019), opportunity recognition (Anwar, Clauss, & Issah, 2021) and risk management (Naldi et al., 2007). We expect all of these to also influence crisis resilience. To create our line of argumentation, we develop our hypotheses in four steps and follow a structure of increasing specificness.

Entrepreneurial orientation strengthens a business

The positive implications of EO on business performance are abundantly discussed in management literature. While Covin and Slevin (1989) developed an early construct of EO based on the prework of Miller (1983) and Khandwalla (1977), Lumpkin and Dess (1996a, 1996b, 2001) refined the concept and were the first to establish strong links between EO and business performance (Basso et al., 2009). For our study, we highlight three characteristics of EO.

First, higher EO allows for opening up new opportunities. Lumpkin and Dess (1996a: 136) connect EO to "processes, practices and decision-making activities that lead to new entry." At the core, their description fits the idea of market expansion, which could take several forms: companies may design new or improve existing products, develop sales in unserved geographical regions, or target new customer segments. Besides this sales-oriented view, EO companies may strive to improve their internal processes along the value chain's primary and supporting activities. More concrete, initiatives may push firms to reconsider their supplier selection and purchasing contracts, review their operational and logistic processes or reshape their after-sale services (primary activities). Moreover, firms may update their human resource management, overall strategic orientation, or research and development focus (secondary activities). In sum, opening up new opportunities is a core characteristic of firms that score high on EO (Kiyabo & Isaga, 2020).

Second, higher EO allows reacting more flexibly. A range of studies researched the EO-flexibility relationship in the context of manufacturing processes (Chahal, Gupta, Lonial, & Raina, 2019; Chang, Lin, Chang, & Chen, 2007) and simultaneously provided reasoning for a generalization of findings. For our purposes, we expand the understanding of the term flexibility to possessing high levels of creativity, skills which help to deal with internal and external unknowns, attitudes of pragmatism, a fair degree of risk tolerance, the willingness to act under conditions of legal uncertainty, strategies to encounter competition, and an affinity to solution-

focused thinking. Related adjectives include being fast, decisive, resistant, and action-oriented. In sum, reacting flexible is a crucial habit of EO organizations (Han & Zhang, 2021).

Third and last, higher EO allows presenting your company as more attractive. Both, Fatoki (2012) and Mason, Floreani, Miani, Beltrame, and Cappelletto (2015) researched the relationship between a firm's EO and its financial structure, particularly its ability to secure debt finance. Their findings confirm that organizations that score high on EO can attract required finance more easily. We build on these results and generalize that EO firms are also more attractive to two groups of people: customers and employees. For customers, EO firms may have a better market perception and are – if buyers are in doubt – preferred over less attractive companies, presumably also because of an elevated brand image. For employees, EO companies may attract talents more efficiently and retain existing ones for longer times (Monsen & Wayne Boss, 2009). In sum, being more attractive results from a firm's motivation to base actions on entrepreneurial thinking.

To conclude, we can state that EO influences company performance in various ways. In most cases, the relationship is positive, i.e., a higher level of EO paves the way to the desired goal. Kiyabo and Isaga (2020) even go further and argue that "[e]ntrepreneurial orientation is an intangible firm resource that creates competitive advantage [...]. Differences in performance among different firms are much driven by intangible rather than physical assets due to the fact that intangible assets, unlike physical assets, are not vulnerable to imitation (Connor, 2002)".

Even though the negative effects of EO are only sparsely covered in academic literature (Soares & Perin, 2019), we consider it essential to also examine whether or in which circumstances EO can be obstructive. We present five thoughts.

First, EO companies might be too autonomic such that they do not collect or even ignore advice from others, only rely on internal and existing knowledge, and disregard potentially valuable external perspectives (Kubicek et al., 2017; Langfred, 2004). Second, EO companies might be lavish when allocating resources to innovation activities such that financial and human

capital is directed at non-viable projects (Bracker & Ramaya, 2011; Srinivasan et al., 2011). Third, EO companies might be too proactive such that their behavior is overly action-focused and not sufficiently observant (Cangiano et al., 2021; Wihler & Jachimowicz, 2016). Fourth, EO companies might be too aggressively facing competition such that they focus on confrontation rather than cooperation with other players; as a result, new, unconventional ideas may not develop (Hoffmann, Lavie, Reuer, & Shipilov, 2018). Fifth and last, EO companies might be too risk-taking (Buyl, Boone, & Wade, 2019) such that actions are pursued without any caution or, alternatively, warning signs are deliberately ignored (Pérez-Luño et al., 2011). In sum, we expect adverse effects of EO on business performance in cases in which select characteristics become too dominant and are pushed beyond reasonable limits.

Short-term market reactions are a reasonable indicator of crisis resilience

Established literature proposes multiple ways to evaluate crisis resilience. For example, DesJardine et al. (2019) and Sajko et al. (2020) apply a stock-market-based approach and decompose organizational resilience into stability (percentage stock price drop) and flexibility (time to recovery). Other researchers rely on qualitative sources, such as interviews and questionnaires (Kantur, 2015; Patriarca, Di Gravio, Costantino, Falegnami, & Bilotta, 2018). For this study, we opted to analyze short-term market reactions and perform an event study to measure crisis resilience and align with the methodology of Heyden and Heyden (2021).

In line with the approach of DesJardine et al. (2019) and Sajko et al. (2020), an event study draws its power from the fact that – assuming rational markets (Fama, Fisher, Jensen, & Roll, 1969) – effects of events are immediately reflected in stock market prices (McWilliams & Siegel, 1997). Given that, event studies are applied in various micro and macro settings, such as the evaluation of earnings announcements, adjustments to a firm's financial structure, changes in a firm's management, new industry-wide regulations, or even global crises (Heyden and Heyden, 2021; MacKinlay, 1997).

Technically, an event study compares the normal or expected return of a stock with the actual stock price performance around the event date. The delta between those returns is accumulated over the length of the event window, such that the resulting measure, i.e., cumulated abnormal returns (CAR), can be further processed in a regression model.

The advantages of performing an event study are twofold. First, the unexpected and exogenous nature of the GFC suggests that firms had little-to-no chances to spontaneously respond at crisis's outbreak. In fact, all firms were hit equally, so that resulting stock price reactions are attributable to firms' preconditions that affected their ability to master the shock (Albuquerque, Koskinen, Yang, & Zhang, 2020). Second, stock prices are not subject to manipulation by insiders (McWilliams & Siegel, 1997). Based on financial market theories, the stock price is the discounted value of all future cash flows and includes all relevant information. Hence, any changes in the stock price due to an event are entirely attributable to a firm's preparedness for a crisis.

To conclude, an event study appears to be an ideal method to establish the causal link between an independent variable, in our case EO, and crisis resilience.

Entrepreneurial orientation influences short-term market reactions in periods of crises

We argue that the positive attributes of EO do not only materialize during times of stable business but also unfold during times of distress. In order to connect EO to stock market reactions in critical times, it is helpful to outline investors' aspirations and mindsets briefly. Investors are obliged to constantly allocate their financial capital, oftentimes according to a determined investment strategy. As such, these investors have options to shift and re-allocate funds but can only act within set limits, e.g., asset classes (Papaioannou, Park, Pihlman, & van der Hoorn, 2015). Especially in times of systemic crises, investors are getting nervous as overall uncertainty rises (Karam, Ryu, & Yang, 2021). Reasons for their increased level of anxiety include the following three aspects. First, prior financial investments of portfolio companies may

become less beneficial as new environmental conditions stop, reduce or defer expected cash flows (Popescu, Neamtu, & Dan Amza, 2009). Second, portfolio companies may not be prepared for the crisis and lack adequate response strategies. Rather than focusing on active crisis mitigation, firms are busy developing and pondering different options, thereby losing valuable time (Claeys & Cauberghe, 2012; Park, 2017). Third and last, portfolio companies may be confronted with unexpected or new competition, which can better or faster deal with the new conditions and hence win market shares from established players (Booth, 2015).

We assume that all these urge investors to reconsider their investment strategy such that they prefer to assign their capital to safer opportunities, e.g., to government bonds. While completely safe investment opportunities do not exist or are limited in supply, investors will also consider – or even prefer – alternative assets with a low-risk profile. These may include stocks of companies that are well diversified, trustworthy, and stable, or have a solid business model, capable management, and an overall positive future outlook (Pirtea, Flavia, & Lucia, 2013). In consequence, stocks that meet low-risk profile characteristics are expected to yield positive abnormal returns. In contrast, those with a high-risk profile are assumed to generate negative abnormal returns.

To substantiate our first hypothesis, we project each of the three arguments that underline the positive EO-performance relationship to the specifics of a systemic crisis. First, higher EO allows to open up new opportunities. In times of systemic distress, the economic environment changes fundamentally so that formerly successful business models lose viability or new, unconventional chances arise (Ritter & Pedersen, 2020). We expect investors to prefer stocks of companies that already possess a list of new opportunities when the crisis sets in. Having alternatives helps companies select the most appropriate ones, considering the specific macroeconomic environment (Chen, Ganesan, & Liu, 2009). Further, such companies can easily diversify and thereby mitigate the risk that in the short-term, beneficial opportunities are

indistinguishable from non-beneficial ones. Lastly, new opportunities may boost revenue and profit figures in the mid-term such that investors' returns increase similarly.

Second, higher EO allows reacting more flexibly. In times of systemic distress, subsequent events and happenings are even more challenging to predict than in times of stable business. The immediate future is unknown, and the micro- and macroenvironment may or may not react as assumed (Lu, 2017). We expect investors to prefer stocks of companies that can quickly reply to new situations and can make decisions "just-in-time" and based on incomplete information (Herek, Janis, & Huth, 1987). We expect that flexible companies can comparably better deal with situations of uncertainty and are willing to actively take action, even though it might turn out that a decision needs to be reverted later on.

Third and last, higher EO allows presenting your company as being more attractive. In times of systemic distress, customers are likely to adjust spending habits and rethink purchase decisions (Cici, Biliginer, & Fatma Gül, 2021; Larios-Gómez, Fischer, Peñalosa, & Ortega-Vivanco, 2021). Further, employees may shift jobs and prefer safer employment options in traditional, crisis-proof industries (Hensvik, Le Barbanchon, & Rathelot, 2021; Kler, Leeves, & Shankar, 2015; Markovits, Boer, & van Dick, 2014). We expect investors to prefer stocks of companies that are more appealing to stakeholders. Focusing on the customer dimension, Kosti et al. (2021) found that during a crisis, households shifted consumption from non-essential products to necessities that carry a higher intrinsic value. Focusing on the HR dimension, we regard skilled, ambitious, and committed personnel as the driving force in managing the crisis (Okay-Somerville & Scholarios, 2019). If suitable employees are already in place, attractive companies can better retain key staff, even though competitors may try to headhunt them. If suitable employees are not already in place, EO companies will have more power to attract key personnel from competitors (Galanaki, 2020; McDonnell & Burgess, 2013).

Considering all this, we expect that the benefits of an EO not only support a business during stable times but also during times of distress. Thus, we hypothesize:

Hypothesis 1 (H1): Firms with a higher EO are more resilient in times of a systemic crisis.

Even though prior arguments for the positive EO-stock market relationship are convincing, we consider it important to also present an alternative perspective. As discussed, extreme levels of EO are likely to negatively affect business performance. We expect that the same holds for crises. In times of a systemic shock, stakeholders and market participants face high levels of uncertainty (Svetlova & Fiedler, 2011): investors revise debt origination, governments increase control, regulators adapt rules, raw material prices fluctuate, suppliers change delivery and payment methods, employees fear job losses, customers adapt spending habits. Strother (2018) found that especially in times of crisis, even minor wrong decisions may entail serious consequences (this idea is also known as the *butterfly effect*). Given that decisions by highly entrepreneurial-oriented firms are tendentially edgy, resulting aftereffects may have serious negative consequences for the whole business.

Financial leverage amplifies the relationship between EO and crisis resilience

The decision on how to fund operations is a fundamental one, and every company needs to find an individual balance between debt and equity finance. Each form has its specific merits and weaknesses in both, times of stable business and during systemic crises. Key differentiators between the two forms, i.e., debt and equity, relate to ownership control, planning and discipline, accessibility, repayment, and taxation (DeNicola, 2020). A frequently used measure to express the dependence on (long-term) debt is financial leverage which is typically calculated as (long-term) debt over total assets. A higher value represents a higher share of debt finance. Since the research stream of a firm's capital structure is utterly large (Kumar, Colombage, & Rao, 2017), we sharply focus our argumentation on the qualitative relationships between EO, business in stable times and during periods of distress, and financial leverage.

Earlier on, we established that an overambitious level of EO hurts business performance in stable times and deduce that the same holds for crises unless a regulating mechanism interferes. As such, we argue that financial leverage does not only take this regulating role but even amplifies the positive influence EO has on crisis resilience. To build our argumentation, we first compare the characteristics of financial leverage in stable times with business in periods of distress.

In general, a low level of financial leverage gives management teams a high degree of freedom: CxOs can realize opportunities at their own discretion, irrespective of whether external parties are in favor or not; low interest expenses allow CxOs to perform manifold investments in a variety of operational projects and sales initiatives; and a solid, debt-controlled financial structure frees up CxO capacity to focus on growth topics rather than administrative ones (Hayes, 2021). In times of stable business, this attained freedom fructifies EO and vice versa such that investors are readily willing to provide financial capital to low-leveraged EO firms. In times of distress, however, the situation differs. Investors are worried that management teams with an overly ambitious EO and a high degree of managerial freedom take incautious and hasty decisions (Carucci, 2017). This significantly increases the risk of burning capital or turning in the wrong strategic direction. Consequently, mitigating factors are required to set efficient bounds for freedom-exploiting leadership teams. We argue that financial leverage can take this role and base our hypothesis on three arguments.

First, if EO companies show an extreme level of autonomy in times of distress, they tend to ignore advice from others and only rely on existing knowledge, thereby disregarding external perspectives (Kubicek et al., 2017; Langfred, 2004). A high level of financial leverage introduces the creditor, i.e., the bank, as an additional stakeholder who contributes a third-party opinion (Sandbu, 2012). Especially if credit lines have to be renegotiated due to crisis-related revenue and profit fluctuations, both parties, i.e., the company and the lending institution, are interested in mutually developing viable solutions for future business success. Given the

specific conditions of a crisis, we expect investors to value financial leverage as a control mechanism to ensure that entrepreneurial autonomy is handled with care.

Second, if EO companies are lavish in times of distress, they tend to invest financial and human capital in economically questionable projects (Bracker & Ramaya, 2011; Srinivasan et al., 2011). A high level of financial leverage urges companies to critically review their investment strategy as debt finance needs to be approved by the creditor and additionally collateralized through recoverable assets. These restrictions generate prudence and unfold steering effects (Beladi, Deng, & Hu, 2021; Ferrando, Marchica, & Mura, 2017). Given the specific conditions of a crisis, we expect investors to value financial leverage as a control mechanism to ensure that entrepreneurial investment is handled carefully.

Third and last, if EO companies show an extreme level of proactivity in times of distress, they tend to make decisions too quickly and without the required caution (Cangiano et al., 2021; Wihler & Jachimowicz, 2016). A high level of financial leverage teaches companies to plan ahead and forces them to show discipline. Debt repayment schemes are accurately determined up on loan origination and include exact interest rates, amortization rates, and due dates. Debtors will have to account for these obligations in their cash flow projections (Moghadam & Jafari, 2015). Further, debtors will have to transfer interest and amortization payments on time, otherwise, creditors will terminate the loan and ask for instant repayment. This may bring debtors into serious trouble, so it is in their own interest to meet their financial commitments. Given the specific conditions of a crisis, we expect investors to value financial leverage as a control mechanism to ensure that entrepreneurial proactivity is handled carefully.

In addition to that, debt finance contains further advantages which are independent of EO. First, debt finance allows the firm's management to stay in control (DeNicola, 2020). If loan installments are paid on time, creditors do not have a say in strategic or operational questions. This includes that generated profits do not need to be shared with creditors. If firms have a strong equity-based capital structure, investors can typically influence the company's strategic

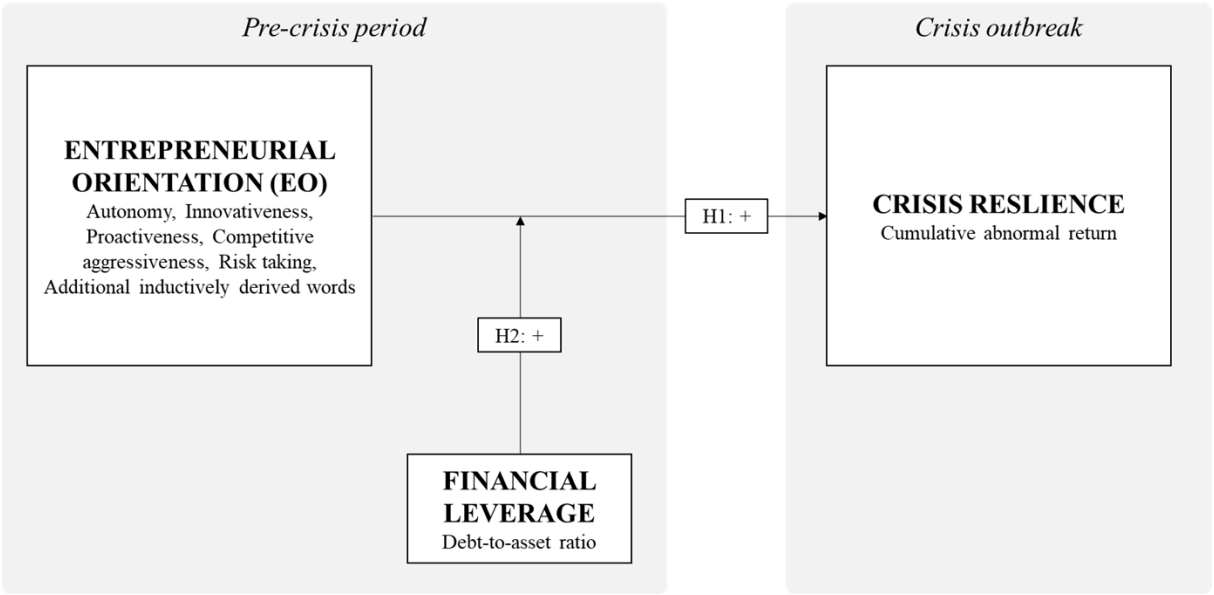
direction and receive profit-based compensation, e.g., in the form of dividends. Second, debt finance is generally related to several points of contact. Exchange and decisions between a firm and its creditor(s) can be quick, direct, and reliable. Such a relationship may also be beneficial if new loans have to be originated within a short time (Maverick, 2021). If firms have a strong equity-based capital structure, they have to deal with many stakeholders who have individual interests. Their alignment is costly – both in terms of time and money. Third, and last, debt finance is cheaper than equity finance, not only because of interests' tax deductibility but also because of debts' seniority in case of liquidations (CFI Education, 2021). As discussed earlier, debt is secured by collateral which can – in case of bankruptcy – be used to repay the creditor. If firms have a strong equity-based capital structure, investors are likely to receive little-to-no compensation for their shares in case of bankruptcy; accordingly, investors will ask for a risk premium on dividends. To conclude, debt finance has several advantages compared to equity finance in times of distress.

Considering all this, we expect that the benefits of financial leverage not only mitigate harmful characteristics of overly ambitious EO companies but even amplify the expected, positive relationship. Thus, we hypothesize:

> *Hypothesis 2 (H2): Financial leverage has a moderating role such that firms with high levels of EO are even more resilient in times of a systemic crisis.*

We graphically summarize our research model as follows:

Figure 1: Research model



Source: own illustration

METHODOLOGY

The methodology partly resembles the prior work of Huesker (2021) and Klein-Peters (2021) and is equally applied to this study. To keep this study comprehensive, select paragraphs and decisions are repeated to ensure methodological consistency.

Sample, time frame, and variable construction

To test our hypotheses, we constructed a sample of public U.S. corporations listed on the S&P 1500. This composite index combines three leading indices for large-, mid-, and small-cap companies to cover approximately 90% of U.S. market capitalization (S&P Dow Jones Indices LLC, 2020b).

In line with prior work, we defined September 17, 2008, as the starting date of the GFC following both Bank of America's acquisition of Merrill Lynch and Lehman Brothers' bankruptcy filing on September 15, as well as the U.S. Federal Reserve's bailout of AIG on September 16, 2008 (DesJardine et al., 2019; Isidore, 2008; Sajko et al., 2020). As a reaction, investors withdrew $144 billion from U.S. money market funds on September 17, thereby causing the short-term lending market – highly important for corporations to fund their daily operations – to freeze (Gullapalli & Anand, 2008).

We consider the GFC an ideal setting for testing our hypotheses: it was unprecedented in its duration and depth, had a global impact, happened unexpectedly, and was sufficiently long to trace effects thoroughly.

We collected data from several sources, together covering the years 1998 to 2013. The 16-year-long period enabled us to construct measures and models flexibly and consider the impact of time. Company fundamentals, e.g., balance sheet accounts and profit and loss items, as well as industry classifications and company identifiers, were obtained from Compustat for the years 1998 to 2015. Daily stock price information was extracted from the Center of Research in Security Prices (CRSP) database for the years 2008 to 2013; this data forms the basis for the

dependent variable indicating cumulative abnormal returns. Annual reports for the years 2003 to 2008 were obtained from SEC's EDGAR (electronic data gathering, analysis, and retrieval) database; this data forms the basis for the independent variable representing EO. We describe the process of constructing the independent variable in the following excursus.

To thoroughly evaluate a company's EO, we followed the approach of Short, Broberg, Cogliser, and Brigham (2010) and constructed six sub-measures, all representing distinct characteristics of EO. We operationalized the computation of these sub-measures through a textual analysis of the sample firm's annual reports, in our case limited to the Management Discussion and Analysis section (Klein-Peters, 2021). Textual analysis is becoming increasingly common in today's accounting and finance research Loughran and McDonald (2015) also because advantages are salient: (1) textual analysis does not rely on primary research and can hence be easily performed for large samples, (2) textual analysis captures a company's strategic orientation through a non-financial metric and is hence less swayed to accounting practices, and (3) textual analysis allows to evaluate a firm's level of innovativeness industry-agnostically as shortcomings of traditional innovation measures (e.g., R&D or patent-based metrics) do not apply. The annual report's MD&A section is precious for our analysis as it is composed by the firm's management and represents "a narrative explanation of the financial statements and other statistical data that the registrant believes will enhance a readers' understanding of its financial condition, changes in financial condition and results of operation. [...] It is intended to provide management with flexibility to describe the financial matters impacting the registrant" (SEC, 2008). Textual analysis of the MD&A section is common practice in academia (Davis & Tama-Sweet, 2012; Li, 2010; Yuthas, Rogers, & Dillard, 2002).

We prepared the data for the textual analysis in two steps. First, we retrieved annual reports for 1,430 out of 1,497 companies (96%); we deemed this success rate sufficient. To reduce confounding effects and endogeneity concerns, we did not consider annual reports filed earlier than July 1, 2003 and later than June 30, 2008. Annual reports filed within the first six

months of a given year were assigned to the previous year as the report's content primarily explains the preceding calendar year's business activity (Klein-Peters, 2021). Second, we removed all annual reports for which the word count of the MD&A section is lower than 27, effectively increasing the minimum word count to 279 for the then shortest report (Klein-Peters, 2021). We thereby neglected data for 137 companies; data for 1,293 companies remained.

To establish each of the six sub-measures, we used the dictionary of Short et al. (2010) (Table 1). Fellow researchers demonstrated a strong link between the word list of Short et al. (2010) and EO or innovative power respectively (Morris, Kuratko, & Covin, 2011; Zhao, 2005). Scores for the six sub-dimensions were calculated by the LIWC2015 language processing software and expressed as a ratio between the count of respective trigger words and the total number of words per MD&A report. The software registered exact matches only, no flections. The aggregation of the six sub-measures into our variable of interest, i.e., EO, follows the idea of Lumpkin and Dess (1996a). They consider EO as "the entire range of organizational activities that involve planning, decision making, and strategic management" (Lumpkin & Dess, 1996a). We describe the mathematical process of data aggregation in the next chapter on measures.

Table 1: Word Lists for entrepreneurial orientation (EO) dimensions (Short et al., 2010)

Entrepreneurial orientation (EO) dimension	Content analysis words with expert validation
Autonomy (Auto)	At-liberty, authority, authorization, autonomic, autonomous, autonomy, decontrol, deregulation, distinct, do-it-yourself, emancipation, free, freedom, freethinking, independence, independent, liberty, license, on-one's-own, prerogative, self-directed, self-directing, self-direction, self-rule, self-ruling, separate, sovereign, sovereignty, unaffiliated, unattached, unconfined, unconnected, unfettered, unforced, ungoverned, unregulated
Innovativeness (Inno)	Ad-lib, adroit, adroitness, bright-idea, change, clever, cleverness, conceive, concoct, concoction, concoctive, conjure-up, create, creation, creative, creativity, creator, discover, discoverer, discovery, dream, dream-up, envisage, envision, expert, form, formulation, frame, framer, freethinker, genesis, genius, gifted, hit-upon, imagination, imaginative, imagine, improvise, ingenious, ingenuity, initiative, initiator, innovate, innovation, inspiration, inspired, invent, invented, invention, inventive, inventiveness, inventor, make-up, mastermind, master-stroke, metamorphose, metamorphosis, neoteric, neoterism, neoterize, new, new-wrinkle, innovation, novel, novelty, original, originality, originate, origination, originative, originator, patent, radical, recast, recasting, resourceful, resourcefulness, restyle, restyling, revolutionize, seethings, think-up, trademark, vision, visionary, visualize
Proactiveness (ProA)	Anticipate, envision, expect, exploration, exploratory, explore, forecast, foreglimpse, foreknow, foresee, foretell, forward-looking, inquire, inquiry, investigate, investigation, look-into, opportunity-seeking, proactive, probe, prospect, research, scrutinization, scrutiny, search, study, survey
Competitive aggressiveness (ComA)	Achievement, aggressive, ambitious, antagonist, antagonistic, aspirant, battle, battler, capitalize, challenge, challenger, combat, combative, compete, competer, competing, competition, competitive, competitor, competitory, conflicting, contend, contender, contentious, contest, contestant, cutthroat, defend, dog-eat-dog, enemy, engage, entrant, exploit, fierce, fight, fighter, foe, intense, intensified, intensive, jockey-for-position, joust, jouster, lock-horns, opponent, oppose, opposing, opposition, play-against, ready-to-fight, rival, spar, strive, striving, struggle, tussle, vying, wrestle
Risk taking (Risk)	Adventuresome, adventurous, audacious, bet, bold, bold-spirited, brash, brave, chance, chancy, courageous, danger, dangerous, dare, daredevil, daring, dauntless, dicey, enterprising, fearless, gamble, gutsy, headlong, incautious, intrepid, plunge, precarious, rash, reckless, risk, risky, stake, temerity, uncertain, venture, venturesome, wager
Additional inductively derived words (AddD)	Advanced, advantage, commercialization, customer-centric, customized, develop, developed, developing, development, developments, emerging, enterprise, enterprises, entrepreneurial, exposure, exposures, feature, features, founding, high-value, initiated, initiatives, innovations, innovative, introductions, launch, launched, leading, opportunities, opportunity, originated, outdoing, outthinking, patents, proprietary, prospects, prototyping, pursuing, risks, unique, ventures

Note / Source: Deductive word lists were developed with the aid of Rodale's (1978) The Synonym Finder. Of the 717 words generated by The Synonym Finder and the 43 words added by our two raters, 244 words were selected by both raters as representative of entrepreneurial orientation and were retained for subsequent analyses.

To construct the final, cross-sectional sample, we identified all companies that were part of the S&P 1500 Composite Index as of September 16, 2008, i.e., one day before the GFC starting date, and obtained 1,497 results. An asynchronous timing of drop-outs and additions explains the difference of three: while drop-outs are recorded immediately, additions are carried

out only once per month (S&P Dow Jones Indices LLC, 2020a). Then, we linked the different data sets to construct the required dependent, independent, and control variables.

First, we joined the entire Compustat database to our sample, leaving us many options to work with a diverse set of measures in the modeling phase. Second, we added daily stock price information from CRSP. For 1,343 firms, we were able to find exactly one security per company; for the remaining 154 companies, we identified up to four simultaneously listed stocks. Companies' primary motivation to introduce additional share classes is the possibility of equipping them with particular voting and dividend characteristics. Since these characteristics influence share price and stock performance, we refrained from consciously selecting one specific asset per company. Instead, we decided to work with trading volume-weighted stock prices to blend differences in stock prices and relative performance over time. Ultimately, our stock price-based measures share the same characteristics as those calculated by DesJardine et al. (2019) and Sajko et al. (2020).

Third, we combined the results from our preceding textual analysis of annual reports. As such, we obtained data for 1,293 companies, worth noting that for only 964 of them, data was complete across all six sub-measures and the full five-year time range. We matched our data with a self-developed crosswalk between the GVKEY and CIK company identifiers.

Fourth and last, we dropped seven firms due to unresolved data inconsistencies between company fundamentals and stock price information. Accordingly, our grand sample consists of 1,490 out of 1,500 maximum possible firms (99.3%). Considering the limited presence of data points from our LIWC analysis, 774 observations enter our model. We ran our models with an observation window of 5 years for the pre-crisis and 2 to 100 days for the post-crisis period, with 10 days being the default. Results for the 2- and 100-day event window were observed but are not printed.

Measures

Descriptions of our measures and data sources are briefly presented in Table 2.

Table 2: Variable key

Variable	Description	Source
Dependent variable		
Cumulative abnormal return (CAR)	Sum of daily abnormal returns calculated for each company; alterations in terms of length of the event window and different types of data adjustment are considered	CRSP
Independent variable		
Entrepreneurial orientation (EO)	Aggregation of MD&A section's word-count weighted sum of trigger words per EO sub-dimension (i.e., autonomy, innovativeness, proactiveness, competitive aggressiveness, risk taking, additional inductively derived words) across the 2003-to-2007-time span	SEC, EDGAR
Control variables		
Firm age	No. of years between 2008 and the year the firm was first covered by Compustat	Compustat
Firm size	Natural logarithm of total assets (mean)	Compustat
Profitability	Ratio of earnings before interest, tax, depreciation, and amortization (EBITDA) to book value of total assets (mean)	Compustat
Capital intensity	Ratio of capital expenditure to book value of total assets (mean)	Compustat
Financial leverage	Ratio of long-term debt to book value of total assets (mean)	Compustat
Intangible assets	Natural logarithm of ratio of market value per share to book value per share (mean)	Compustat
Slack resources	Ratio of long-term debt to market value of equity (mean)	Compustat
Pre-crisis stock price	Closing stock price on September 16, 2008	CRSP
Industry dummy	Dummy variable representing the industry division based on a 2-digit SIC code	Compustat

Abbreviations: CRSP = Center for Research in Security prices; EBITDA = Earnings before interest, tax, depreciation, and amortization; EO = Entrepreneurial orientation (independent variable); GFC = global financial crisis; MD&A = Management Discussion and Analysis; SEC = United States Securities and Exchange Commission; SIC = Standard Industrial Classification; *Note:* (mean) indicates that simple averages are used if independent variables are measured for multiple years

Dependent variables: Cumulative abnormal returns (CAR)

We followed Kliger and Gurevich (2014), MacKinlay (1997), and McWilliams and Siegel (1997) and computed our dependent variable, i.e., cumulative abnormal returns (CAR), in a preceding event study. The underlying mechanics are extensively discussed in the method of analysis chapter. We considered different lengths of event windows (2, 5, 10, 25, 50, and 100 days) as well as two principal types of data adjustment: market adjusted model and market model. Results from the market model are used for robustness checks.

Independent variable: Entrepreneurial orientation (EO)

We followed Short et al. (2010) and constructed the measure for EO in three steps. First, and based on the above-described textual analysis of annual reports, we constructed six scores for each firm-year observation: Autonomy (Auto), Innovativeness (Inno), Proactiveness (ProA), Competitive aggressiveness (ComA), Risk-taking (Risk), and Additional inductively derived words (AddD). Second, we derived for each firm-year observation a new variable representing EO, whereas t denotes any given year:

$$EO_t = Auto_t + Inno_t + ProA_t + ComA_t + Risk_t + AddD_t$$

Third and last, we transformed the five EO_t variables into one comprehensive word count (WC) weighted measure for each firm, covering the whole five-year period:

$$EO = \frac{\sum_{t=2003}^{2007} EO_t * WC_t}{\sum_{t=2003}^{2007} WC_t} \quad (1)$$

Control variables

To isolate the impact of our independent variables, we included nine controls in our study. The selection and calculation of control variables are identical for all our models and partly resemble the prior work of DesJardine et al. (2019) and Sajko et al. (2020).

Firm age is the difference between 2008 and the year in which Compustat first covered the company. We assume that older firms have experienced and successfully managed various past crises so that they are more likely to have acquired relevant skills and knowledge to react to adverse events. *Firm size* is the natural logarithm of assets. Findings of Fort, Haltiwanger, Jarmin, and Miranda (2013) show that firm size is a decisive factor when evaluating performance throughout the business cycle; in their study, small businesses are hit particularly strong during downturns. *Profitability* equals the ratio of earnings before interest, tax, depreciation, and amortization (EBITDA) to the book value of total assets. We believe that the cost-income structure of firms does influence investment activities. Besides the variable's use as a control, we employ the metric as a moderator representing a firm's level of sense of urgency. A

comparably low level of profitability translates into a high sense of urgency, while a comparably high level of profitability translates into a low sense of urgency. *Capital intensity* is the ratio of capital expenditure to the book value of total assets. As such, Gittell et al. (2006) researched the September 11, 2001 attacks and argued that capital-intensive airlines performed worse than those with less capital employed. *Financial leverage* is the ratio of long-term debt to the book value of total assets. Less leveraged firms obtain a smaller portion of the financing needs from debt and are hence less risky. If investors prefer safer investments during economic crises, highly leveraged firms are hit harder and recover later. Financial leverage is also used as a moderator variable. *Intangible assets* equals the natural logarithm of market value per share to book value per share. This ratio captures the premium investors are willing to pay for goodwill, brand recognition, and corporate reputation. A higher ratio is an indicator of higher reputation (or similarly, goodwill and brand recognition) and thus higher expected future performance (Fombrun, Gardberg, & Sever, 2000). *Slack resources* is the ratio of long-term debt to market value of equity. George (2005) and Mosakowski (2002) discuss how the availability of resources impacts firm performance. In essence, the effects of scarce and slack resources are ambiguous: they can either negatively or positively impact firm performance (e.g., scarce resources may defer essential investments, but they may also enhance capabilities through finding creative solutions; excess resources may allow the management to focus on innovative projects, but they may also mislead decision-makers to undertake other-than-economic projects). We acknowledged this ambivalence by controlling for resource availability. *Pre-crisis stock price* is the closing stock price as of September 16, 2008, and accounts for different absolute price levels. *Industry dummies* are defined by firms' two-digit SIC (Standard Industrial Classification) codes. These dummies absorb all effects specific to an industry and further consider that investors may shift their focus to more stable businesses in challenging times (e.g., to utilities).

Method of analysis

To test our hypotheses, we employed an event study model and proceeded in two steps. First, we calculated the CAR for each sample company. Second, we ran an OLS regression, for which the CAR measure served as the dependent and EO along with all controls and moderators or mediators as the independent variables. While running an OLS regression is standard practice in academia, the focus of this paragraph shall lie on the specifics of the event study.

An event study estimates the effect of an unanticipated event on stock prices by calculating the non-expected, i.e., abnormal, returns (McWilliams & Siegel, 1997). While renowned researchers such as Fama et al. (1969) and Ball and Brown (1968) introduced event studies in the context of financial research in the 1960s, it gained popularity in many other fields over time, e.g., management, marketing, and political science (Corrado, 2011; MacKinlay, 1997). Sood and Tellis (2009: 442) even identify "abnormal stock market returns [...] [as] one of the best means of assessing the true rewards to innovation" as the CAR measure captures firm value under the assumptions of the efficient market hypothesis (Fama et al., 1969). We aligned our statistical setup to the prework of Kliger and Gurevich (2014), MacKinlay (1997), and McWilliams and Siegel (1997) and limit our remarks to result-influencing decisions.

We calculated the CAR according to the mechanics of the adjusted market model (a.k.a. the naïve benchmark model). A second and third model, the market model (a.k.a. the single-factor benchmark model) and the excess return model are not in focus and are used for robustness checks only (Klein-Peters, 2021). The adjusted market model assumes a constant expected stock return which equals the market return (Kliger & Gurevich, 2014). Accordingly, the estimated normal return (NR) for each stock i at time t is

$$NR_t^i = R_t^m \tag{2}$$

where R_t^m is the market return at period t. Accordingly, for calculating the abnormal returns (AR) for stock i at period t, the normal expected returns NR_t^i are subtracted from the actual return (R) of a company i in the period t of the event (Klein-Peters, 2021)

$$AR_t^i = R_t^i - NR_t^i = R_t^i - R_t^m \quad (3)$$

Computation of all daily abnormal returns accrued during an event window leads to a company-specific CAR in the observation period. Thus, the CAR output variable for the adjusted market model equals

$$CAR_{s,t}^i = \sum_{p=s}^{t} AR_p^i \quad (4)$$

where $CAR_{s,t}^i$ is firm i's estimated CAR from period s to t, and AR_p^i is firm i's estimated AR at period p.

The market model yields improved statistical efficiency as it acknowledges the existence of individual differences in stock returns for each company and captures them with risk coefficients, the stocks' betas (β) (Klein-Peters, 2021). The basic relation between stock i's normal and market returns equals

$$NR_t^i = \alpha_i + \beta_i R_t^m \quad (5)$$

where NR_t^i is the firm i's estimated normal return at time t, R_t^m is the market return in period t, and α_i and β_i are the model's parameters (Klein-Peters, 2021). Equations (3) and (4) apply likewise to the market model. To satisfy this model's requirement for a reference index, we followed McWilliams and Siegel (1997) and opted for the S&P 500 benchmark. The 500 companies represented in this very index are also part of our sample and hence a reasonable fit.

When running an event study, the choice of the event window, i.e., the length of time abnormal returns are tracked, is critical for the statistical output (Kliger & Gurevich, 2014). Among researchers, there is no common agreement about the optimal length of the event window, however, shorter periods are typically preferred over longer ones (MacKinlay, 1997). The primary reason for choosing short event windows relates to the concern that longer event windows may contain confounding events that may distort the statistical analysis. As such, McWilliams and Siegel (1997) propose event windows of two days, while in the case of the GFC, longer event windows are equally justifiable (Calomiris, Love, and Martínez Pería, 2012).

The latter view is substantiated by the fact that the S&P 500 index showed predominantly positive or stable returns between September 16 and October 1, 2008 and started to systemically decline only hereinafter. To face this potential concern, we ran our analysis with six different event windows, namely 2, 5, 10, 25, 50, and 100 days, and describe respective results in the robustness tests section. Results for the 2 and 100-day event windows have been observed and assessed but are not printed in a table format.

RESULTS

We arranged this chapter as follows: First, we present summary statistics for our data set. Second, we examine the results of our statistical analysis. Finally, we underline our findings by a series of diagnostic and robustness checks.

Summary statistics

Table 3 provides descriptive statistics as well as the correlation coefficients for each variable presented in Table 2. On average, the cumulative abnormal returns under the market adjusted model for a 10-day event window equal -7% and fluctuate with a standard deviation (SD) of 12%. For shorter time periods, the CAR increases to -4% (SD: 8%; 5 days) or even becomes positive (+4%, SD: 7% for 2 days, not printed). For longer event windows, i.e., 25, 50 and 100 days, the CAR equals -41%, -34% and -37% (not printed), with increasing volatility (SD: 26%, 40%, 44%). Results are comparable when evaluating the key descriptives from the market model approach. Overall, the descriptive statistics suggest that the negative effects of the GFC are mid- to long- and not short-term. We consider this as additional backing to prefer longer event windows, i.e., those of 10+ days. The EO variable cannot be interpreted numerically, as the figure is a multi-stage aggregation; however, the mean (1.11), standard deviation (0.40), minimum (0.40), maximum (3.30), and skewness (1.51) provide an idea of the variable's distribution. In all models, the EO variable – like all other variables – is centered and standardized to allow for cross-model comparisons. Bivariate correlations between EO and other variables are unsuspicious (i.e., no coefficient exceeds 0.11; refer to Table 3, both line and Column 5).

Table 3: Means, standard deviations, and bivariate correlations

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. CAR, MktAdj, 10d	-0.07	0.12												
2. CAR, MktAdj, 5d	-0.04	0.08	0.58*											
3. CAR, MktAdj, 25d	-0.41	0.26	0.61*	0.30*										
4. CAR, MktAdj, 50d	-0.34	0.40	0.42*	0.21*	0.68*									
5. Entrepreneurial orientation (EO)	1.11	0.40	0.11*	0.11*	0.08*	0.07*								
6. Firm age	27.13	15.77	0.03	0.02	0.03	0.04	-0.14*							
7. Firm size	7.27	1.42	-0.08*	-0.09*	-0.04	-0.04	-0.06	0.47*						
8. Profitability	0.14	0.08	0.07	0.06	0.11*	0.07	-0.15*	-0.07	-0.02					
9. Capital intensity	0.05	0.05	-0.08*	0.08*	-0.03	-0.10*	-0.08*	-0.05	0.05	0.37*				
10. Financial leverage	0.16	0.14	0.00	-0.01	-0.03	-0.04	-0.14*	0.21*	0.36*	-0.15*	0.04			
11. Intangible assets	1.04	0.60	0.02	0.02	0.13*	0.05	0.23*	-0.13*	-0.09*	0.36*	-0.01	-0.03		
12. Slack resources	0.37	3.96	0.00	-0.01	0.03	0.02	-0.04	0.04	0.03	-0.01	-0.02	0.05	-0.05	
13. Pre-crisis stock price	32.94	36.72	0.00	0.05	0.11*	0.08*	0.00	0.12*	0.20*	0.22*	0.04	0.00	0.12*	0.00

Note: Variables 1 to 4 are different alternatives for the model's dependent variable, with variable 1 being the default; as it is statistically not reasonable to use DVs simultaneously, correlation coefficients are omitted; Variable 5 represents the model's IV; all others are controls or moderators, n = 774
Abbreviations: CAR = Cumulative abnormal return; MktAdj = Market adjusted model; d = length of event window in days
* $p < 0.05$

Main results

We report results from our OLS regressions in Tables 4 and 5 and differentiate between four event windows: 5, 10, 25, and 50 days, with 10 days as the base case. Results for an event window of 2 days are statistically insignificant, while those for the 100-day event window are in line with the outcomes of the 50-day period.

We find strong support for H1: Firms with a higher EO are more resilient in times of a systemic crisis. Effects are stronger when event windows become larger (10d: $B = 0.020$, $p < 0.001$ (Table 4, Column 2); 25d: 0.019, $p < 0.05$ (Table 4, Column 6); 50d: 0.036, $p < 0.05$ (Table 4, Column 8). For short event windows, influence of EO loses relevance as coefficients and significance levels indicate (2d: $B = 0.004$, $p > 0.1$ (not printed); 5d: $B = 0.010$, $p < 0.01$ (Table 4, Column 4)). We further find support for H2: Financial leverage affects the power of entrepreneurial orientation on CAR during times of systemic crises. Especially when considering longer event windows, i.e., those of 25+ days, the additional contribution of a one standard deviation increase in financial leverage ranges between 75% and 89% (50d: 0.030/0.040 (Table 4, Column 9); 100d: 0.036/0.041 (not printed)).

Quantitative results represented in Table 5 provide additional insights and explain that the positive EO:Financial leverage relation does not hold in any situation. As such, we acknowledge that firms with an under-average level of EO cannot benefit from financial leverage. As Table 5, Columns 1, 4 and 7 indicate contributions of EO to CAR are close to zero (5d: 0.005; 10d: 0.006; 25d: 0.003) and statistically insignificant. A graphical representation is depicted in Figure 2.

Table 4: Regression results for event study specified as a market adjusted model with different event windows on EO

	Dependent variable: CAR, Market adjusted model								
Event window	10 days			5 days		25 days		50 days	
Variable	**(1) Controls**	**(2) OLS**	**(3) OLS, Mod.**	**(4) OLS**	**(5) OLS, Mod.**	**(6) OLS**	**(7) OLS, Mod.**	**(8) OLS**	**(9) OLS, Mod.**
Entrepreneurial orientation		0.020***	0.022***	0.010**	0.011**	0.019*	0.022*	0.036*	0.040**
(EO)		(0.006)	(0.005)	(0.004)	(0.004)	(0.009)	(0.009)	(0.015)	(0.015)
EO:Financial leverage			0.016***		0.006.		0.019*		0.030*
			(0.005)		(0.003)		(0.008)		(0.014)
Firm age	0.008.	0.011*	0.010*	0.007*	0.007*	0.005	0.004	0.014	0.013
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.010)	(0.010)	(0.015)	(0.015)
Firm size	-0.018**	-0.020***	-0.019***	-0.020***	-0.019***	-0.014	-0.013	-0.029	-0.027
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.010)	(0.010)	(0.018)	(0.018)
Profitability	0.016*	0.021**	0.024***	0.011**	0.012**	0.032**	0.035**	0.061**	0.065**
	(0.008)	(0.007)	(0.006)	(0.004)	(0.004)	(0.011)	(0.011)	(0.022)	(0.022)
Capital intensity	-0.010*	-0.012**	-0.013**	-0.003	-0.004	0.002	0.001	-0.036.	-0.038.
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.010)	(0.010)	(0.020)	(0.020)
Financial leverage	-0.005	-0.001	-0.004	-0.002	-0.003	-0.016	-0.019.	-0.025	-0.030
	(0.005)	(0.005)	(0.005)	(0.004)	(0.003)	(0.011)	(0.011)	(0.021)	(0.021)
Intangible assets	0.002	-0.003	-0.005	-0.000	-0.001	0.016	0.014	-0.007	-0.010
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.010)	(0.010)	(0.023)	(0.023)
Slack resources	-0.000	-0.000	-0.000	-0.001.	-0.001.	0.009**	0.009**	0.011*	0.011*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.005)	(0.005)
Pre-crisis stock price	-0.005	-0.005	-0.005	0.000	-0.000	0.013	0.013	0.015	0.015
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.011)	(0.011)	(0.019)	(0.018)
Constant	-0.069***	-0.060***	-0.029.	0.045***	0.056***	-0.345***	-0.309***	-0.334***	-0.278***
	(0.014)	(0.014)	(0.017)	(0.009)	(0.010)	(0.029)	(0.032)	(0.060)	(0.064)
Industry dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included
Observations	774	774	774	774	774	774	774	774	774
Adjusted R^2	0.175	0.195	0.211	0.171	0.175	0.205	0.209	0.150	0.154
Residual standard error	0.109	0.108	0.107	0.074	0.074	0.228	0.227	0.371	0.371
	(df = 706)	(df = 705)	(df = 704)	(df = 705)	(df = 704)	(df = 705)	(df = 704)	(df = 705)	(df = 704)
F Statistic	3.455***	3.759***	3.988***	3.346***	3.373***	3.927***	3.953***	3.006***	3.037***

Note: Values are presented as B (SE) unless noted otherwise; Standard errors are robust; Numeric variables have been centered and standardized
*** p < 0.001, ** p < 0.01, * p < 0.05, . p < 0.1

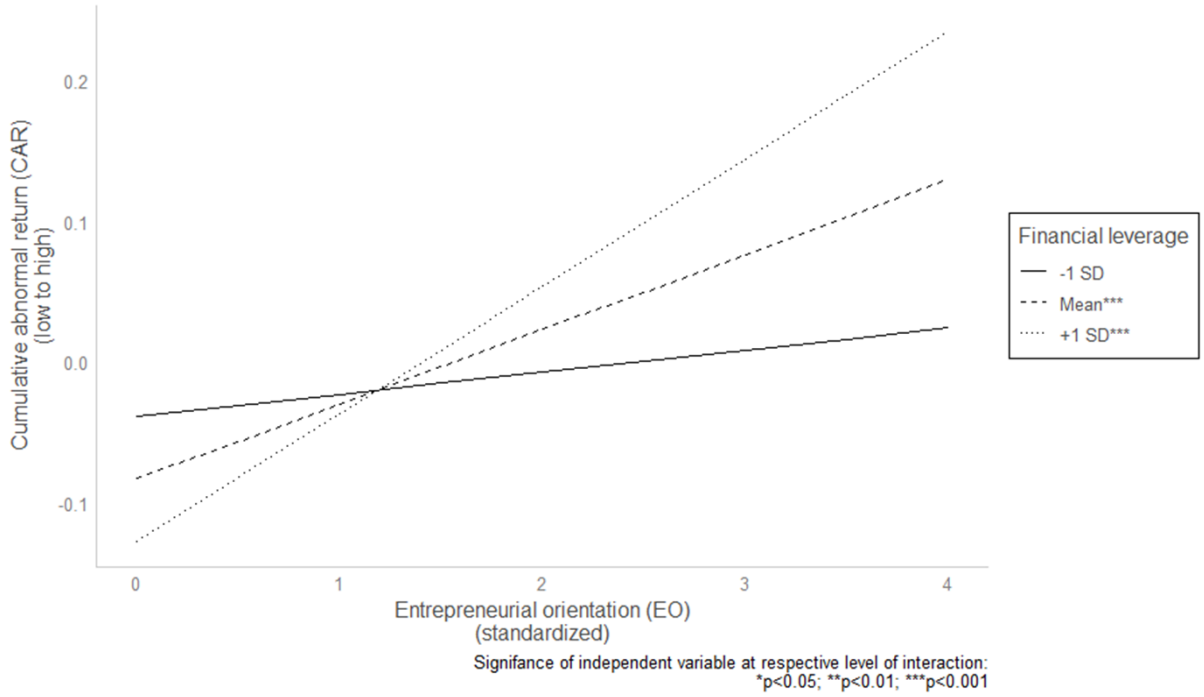
Table 5: Slope tests on moderator financial leverage for analysis of Entrepreneurial orientation (EO) for market adjusted model

	Dependent variable: CAR, Market adjusted model								
Event window	10 days			5 days			25 days		
Variable	**(1) -1 SD**	**(2) Mean**	**(3) +1 SD**	**(4) -1 SD**	**(5) Mean**	**(6) +1 SD**	**(7) -1 SD**	**(8) Mean**	**(9) +1 SD**
Entrepreneurial orientation	0.006	0.022***	0.038***	0.005	0.011**	0.017**	0.003	0.022*	0.041**
(EO)	(0.006)	(0.005)	(0.009)	(0.004)	(0.004)	(0.006)	(0.011)	(0.009)	(0.014)
EO:Financial leverage	0.016***	0.016***	0.016***	0.006.	0.006.	0.006.	0.019*	0.019*	0.019*
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.008)	(0.008)	(0.008)
Firm age	0.010*	0.010*	0.010*	0.007*	0.007*	0.007*	0.004	0.004	0.004
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.010)	(0.010)	(0.010)
Firm size	-0.019***	-0.019***	-0.019***	-0.019***	-0.019***	-0.019***	-0.013	-0.013	-0.013
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.010)	(0.010)	(0.010)
Profitability	0.024***	0.024***	0.024***	0.012**	0.012**	0.012**	0.035**	0.035**	0.035**
	(0.006)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)	(0.011)	(0.011)	(0.011)
Capital intensity	-0.013**	-0.013**	-0.013**	-0.004	-0.004	-0.004	0.001	0.001	0.001
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.010)	(0.010)	(0.010)
Financial leverage	-0.004	-0.004	-0.004	-0.003	-0.003	-0.003	-0.019.	-0.019.	-0.019.
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.011)	(0.011)	(0.011)
Intangible assets	-0.005	-0.005	-0.005	-0.001	-0.001	-0.001	0.014	0.014	0.014
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.010)	(0.010)	(0.010)
Slack resources	-0.000	-0.000	-0.000	-0.001.	-0.001.	-0.001.	0.009**	0.009**	0.009**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)
Pre-crisis stock price	-0.005	-0.005	-0.005	-0.000	-0.000	-0.000	0.013	0.013	0.013
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.011)	(0.011)	(0.011)
Constant	-0.025	-0.029.	-0.033*	0.059***	0.056***	0.053***	-0.290***	-0.309***	-0.328***
	(0.020)	(0.017)	(0.014)	(0.013)	(0.010)	(0.009)	(0.041)	(0.032)	(0.025)
Industry dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included
Observations	774	774	774	774	774	774	774	774	774
Adjusted R^2	0.211	0.211	0.211	0.175	0.175	0.175	0.209	0.209	0.209
Residual Std. Error (df = 704)	0.107	0.107	0.107	0.074	0.074	0.074	0.227	0.227	0.227
F Statistic (df = 69; 704)	3.988***	3.988***	3.988***	3.373***	3.373***	3.373***	3.953***	3.953***	3.953***

Note: Values are presented as B (SE) unless noted otherwise; Standard errors are robust; Numeric variables have been centered and standardized

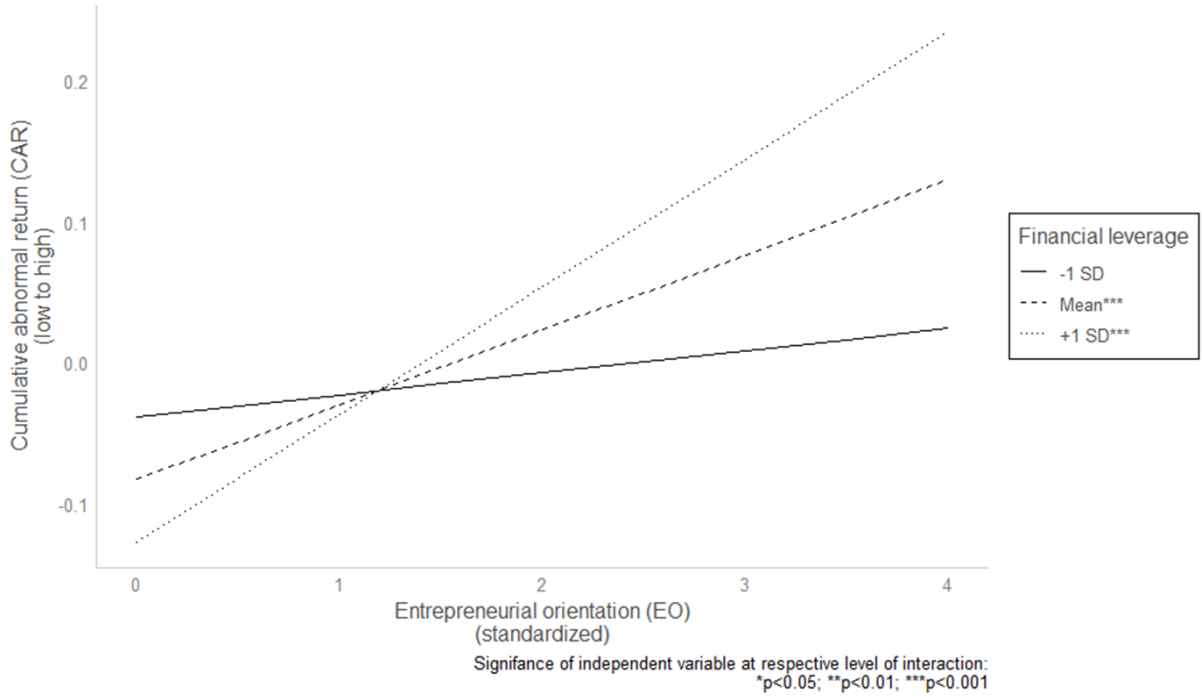
*** p < 0.001, ** p < 0.01, * p < 0.05, . p < 0.1

Figure 2: Joint effect of EO and financial leverage on CAR, 10d, market adjusted model



Source: own illustration

Figure 3: Joint effect of EO and financial leverage on CAR, 10d, market model



Source: own illustration

Main findings and theoretical backing

Based on our statistical analysis, we are able to confirm both H1 and H2. Besides different levels of statistical significance, our results are robust against variations in event window lengths and types of data adjustment. However, before substantiating our outcomes with established theories, we see value in briefly interpreting the findings.

For H1, statistical significances are acceptable for all lengths of event windows (exception: 2 days), even though p-values increase for longer periods. Similarly, we see higher coefficients for the EO measure for longer periods. We interpret these observations as follows. Increasing the length of event windows to, e.g., 25, 50, or even 100 days, opens room for the occurrence of confounding events – may they be positive or negative (Krivin, Patton, Rose, & Tabak, 2003). These distorting effects harm the interpretational power of our independent variable, EO, such that statistical proof weakens (indicated by higher p-values). While the outbreak of the GFC had an alike, systemic influence on all companies, subsequent events have a company-specific character that does not necessarily need to be related to the GFC. Examples could include product recalls, data breaches, or regional natural disasters. Our explanation for higher coefficients is less corroborated but may include the following thought. Shortly after the outbreak of the GFC, investors were urged to make quick decisions and adjust their investment allocation. While the time for in-depth financial research was potentially limited, the decision criterion of gut feeling may have gained importance. Short-term investment decisions are hence less substantiated than in times of stable business (Arand & Kerl, 2012). As time passes, e.g., to event windows of 25+ days, investors could assign more of their time to detailed, fundamental research of individual stocks. As such, true EO firms were identified and extraordinarily demanded. In addition, the longer event window period allowed investors to better check if EO firms did actually display better in-crisis management in both qualitative and quantitative dimensions than low-EO firms. Both thoughts underline that the 10d event window as a default is justifiable.

For H2, we acknowledge minor statistical significances in the EO:Financial leverage moderation for shorter event windows. We do not consider those shortcomings as material since the results for our default, 10d period are convincing. Remarkably, financial leverage does never have a statistically significant effect on crisis resilience (Table 4, Columns 1 and 2). Hence, capital markets do not prefer or denigrate a specific capital structure during times of distress; this fundamentally strengthens H2 as financial leverage principally reacts to the degree of EO. Focusing on the details of the moderation, we acknowledge two contrasting situations: for an average and over-average level of EO, statistical significances are high (Table 5, Columns 2 and 3); for an under-average level of EO, statistical significances are non-existent (Table 5, Column 1). We combine these findings to stress our argument that financial leverage has a strong, corrective character. For firms with an under-average EO, financial leverage can naturally not exert this compensating role since there are no – or only minor – negative EO characteristics to offset. For firms with an average or even over-average level of EO, the beneficial influences debt financing exerts on EO during times of distress are well accounted for. The compensating and amplifying effects of financial leverage are notably strong (Table 4, Column 3; $B = 0.016$, $p < 0.001$).

We underline our findings with established theories: contingency theory (Galbraith, 1973) and human capital theory (Becker, 1964). First, we consider the contingency theory. Building on Galbraith (1973), Scott (2005: 89) explains that the theory "is guided by the [...] hypothesis that organizations whose internal features best match the demands of their environment will achieve the best adaptation." We see a good fit of this theory in two areas. On the one hand, it bases on internal features a company developed over time, in our case EO. As discussed earlier, the EO measure is an aggregate of five sub-dimensions whose underlying features can neither be developed within a short time nor can they be purchased with money. Instead, it has to evolve, to be backed by top management and fueled by a comprehensive company culture. We understand EO as a complex result of a long-lasting process rather than a purposely created

construct (Mazzarol, 2013). On the other hand, the contingency theory bases on the concept of adaptation to the environment. Particularly during a systemic crisis, environmental changes are serious and affect not only select firms but the economy as a whole. As such, only those succeed who can best use their acquired EO skillset to master the adverse situation. This includes the balancing and amplifying effect financial leverage has on firms with an unhealthy intense level of EO.

Second, we consider the human capital theory. Building on Becker (1964), Unger, Rauch, Frese, and Rosenbusch (2011: 341) state a "positive relationship between human capital and success" and refine that "human capital increases owners' capabilities of discovering and exploiting business opportunities [by acquiring] financial and physical capital and [assisting] in the accumulation of knowledge and skills." Mthanti and Ojah (2018: 135) extent the positive human capital-success relationship to a human capital-EO nexus which is "robust across economic development levels." Referring to the construct of EO itself, we set forth that many EO characteristics could also describe the character, drive, or motivation of individual employees. Accordingly, we establish that investments in human capital, e.g., education, training, experience, and recruitment, lead to desirable outcomes of human capital, e.g., knowledge, skills, and abilities, and as such strengthen a firm's EO.

Diagnostic and robustness tests

To check our results for robustness, we ran a battery of tests and can eventually confirm that our findings hold under different settings.

First, we ran our analysis on three different models, i.e., market adjusted model (Table 4, Table 5) and market model (Table 6, Table 7), and eventually verified our finding with a third, the excess returns model (results not printed). The retrieved coefficients and statistical significances for the latter match the results from the market adjusted model.

Second, we reviewed results for event windows shorter than 5 and longer than 50 days, i.e., 2 days and 100 days respectively: statistical outcomes of the 2-day event window follow the development observed for the 5-day event window but are statistically insignificant; statistical outcomes of the 100-day event window follow the development observed for the 50-day event window. Even shorter or longer event windows are not considered as their application is not substantiated in academic literature (McWilliams & Siegel, 1997).

Third, we pursued adjustments to the set of control variables, i.e., measuring firm size based on sales instead of assets, measuring profitability as EBITDA over sales instead of assets, removing all control variables individually, and received highly comparable results.

Fourth, we pursued the standard checks for OLS model assumptions and can state that all hold. We confirmed linearity, constant error variance (homoscedasticity), and independent error terms by inspecting residual plots. We double-checked the latter by a series of Durbin-Watson (DW) tests, all yielding DW coefficients between 1.99 and 2.12 ($0.40 < p < 0.94$). Consequently, we accepted the Durbin-Watson test's null hypothesis that the autocorrelation of disturbances is equal to zero and hence not a concern. We confirmed the normality of errors by checking QQ-Plots. We further ran a set of tests to check for multicollinearity, especially since select correlations between some variables are noticeably high. Variance inflation factors, calculated as both GVIF and GVIF^(1/(2*Df)), for the variables in each model are well below the established threshold of 5 and 2 respectively (Johnston, Jones, & Manley, 2018). We consider two exceptions in industry dummies as non-material. Lastly, we also investigated condition numbers, which turned out to be lower than the established threshold of 30 but also below the more conservative cut-off points of 10 and 5. We classify an exception in the industry dummy factor variable as non-significant because removing this control variable does not alter our main findings. To conclude, we did not find any material indication that our models suffer from multicollinearity.

For completeness, we followed Echambadi and Hess (2007: 444) and reran our models on smaller subsamples "to test the plausibility and stability of coefficients [as] unstable coefficients across these random subsets of data may confirm the presence of collinearity problems." Since statistical significances and coefficients' algebraic signs remained stable, and coefficient sizes only changed marginally, we assume that the presented results are reliable.

Overall, we can confirm that our results remain stable even if we change key parameters. We can hence corroborate our findings.

Table 6: Regression results for event study specified as a market model with different event windows on EO

	Dependent variable: CAR, Market model								
Event window	10 days			5 days		25 days		50 days	
Variable	**(1) Controls**	**(2) OLS**	**(3) OLS, Mod.**	**(4) OLS**	**(5) OLS, Mod.**	**(6) OLS**	**(7) OLS, Mod.**	**(8) OLS**	**(9) OLS, Mod.**
Entrepreneurial orientation		0.021***	0.023***	0.010**	0.010**	0.010	0.012	0.044*	0.046*
(EO)		(0.005)	(0.005)	(0.004)	(0.004)	(0.010)	(0.010)	(0.019)	(0.019)
EO:Financial leverage			0.013**		0.004		0.010		0.014
			(0.005)		(0.003)		(0.009)		(0.018)
Firm age	0.006	0.009.	0.009.	0.007*	0.006*	0.000	0.000	0.011	0.011
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.010)	(0.010)	(0.018)	(0.018)
Firm size	-0.013*	-0.016**	-0.015**	-0.018***	-0.018***	-0.006	-0.005	-0.016	-0.015
	(0.006)	(0.006)	(0.005)	(0.004)	(0.004)	(0.011)	(0.011)	(0.021)	(0.021)
Profitability	0.015.	0.021**	0.023***	0.010*	0.011*	0.025*	0.027*	0.065*	0.068*
	(0.008)	(0.007)	(0.006)	(0.005)	(0.004)	(0.011)	(0.011)	(0.027)	(0.027)
Capital intensity	-0.013*	-0.015**	-0.016**	-0.005	-0.005	-0.005	-0.005	-0.068**	-0.069***
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.011)	(0.011)	(0.021)	(0.021)
Financial leverage	-0.006	-0.001	-0.004	-0.001	-0.002	-0.010	-0.012	-0.022	-0.025
	(0.005)	(0.005)	(0.005)	(0.004)	(0.003)	(0.011)	(0.011)	(0.024)	(0.024)
Intangible assets	0.004	-0.001	-0.002	0.001	0.001	0.024*	0.023*	-0.005	-0.006
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.010)	(0.010)	(0.026)	(0.026)
Slack resources	-0.000	-0.000	-0.000	-0.001*	-0.001*	0.006**	0.006**	0.015**	0.015**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.005)	(0.005)
Pre-crisis stock price	-0.011**	-0.011**	-0.011**	-0.004.	-0.004.	-0.021***	-0.021***	-0.022*	-0.022*
	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.006)	(0.006)	(0.011)	(0.011)
Constant	-0.002	0.008	0.033*	0.095***	0.103***	-0.017	0.001	0.122.	0.149.
	(0.014)	(0.014)	(0.017)	(0.009)	(0.011)	(0.029)	(0.035)	(0.069)	(0.076)
Industry dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included
Observations	774	774	774	774	774	774	774	774	774
Adjusted R^2	0.170	0.191	0.201	0.142	0.143	0.226	0.226	0.173	0.172
Residual standard error	0.113	0.112	0.111	0.076	0.076	0.233	0.233	0.431	0.431
	(df = 706)	(df = 705)	(df = 704)	(df = 705)	(df = 704)	(df = 705)	(df = 704)	(df = 705)	(df = 704)
F Statistic	3.358***	3.690***	3.817***	2.882***	2.876***	4.326***	4.280**	3.371***	3.331***

Note: Values are presented as B (SE) unless noted otherwise; Standard errors are robust; Numeric variables have been centered and standardized
*** p < 0.001, ** p < 0.01, * p < 0.05, . p < 0.1

Table 7: Slope tests on moderator *Financial leverage* for analysis of Entrepreneurial orientation (EO) for market model

	Dependent variable: CAR, Market model								
Event window	10 days			5 days			25 days		
Variable	**(1) -1 SD**	**(2) Mean**	**(3) +1 SD**	**(4) -1 SD**	**(5) Mean**	**(6) +1 SD**	**(7) -1 SD**	**(8) Mean**	**(9) +1 SD**
Entrepreneurial orientation	0.010.	0.023***	0.036***	0.006	0.010**	0.015*	0.002	0.012	0.021
(EO)	(0.006)	(0.005)	(0.008)	(0.004)	(0.004)	(0.006)	(0.010)	(0.010)	(0.015)
EO:Financial leverage	0.013**	0.013**	0.013**	0.004	0.004	0.004	0.010	0.010	0.010
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.009)	(0.009)	(0.009)
Firm age	0.009.	0.009.	0.009.	0.006*	0.006*	0.006*	0.000	0.000	0.000
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.010)	(0.010)	(0.010)
Firm size	-0.015**	-0.015**	-0.015**	-0.018***	-0.018***	-0.018***	-0.005	-0.005	-0.005
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.011)	(0.011)	(0.011)
Profitability	0.023***	0.023***	0.023***	0.011*	0.011*	0.011*	0.027*	0.027*	0.027*
	(0.006)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)	(0.011)	(0.011)	(0.011)
Capital intensity	-0.016**	-0.016**	-0.016**	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.011)	(0.011)	(0.011)
Financial leverage	-0.004	-0.004	-0.004	-0.002	-0.002	-0.002	-0.012	-0.012	-0.012
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.011)	(0.011)	(0.011)
Intangible assets	-0.002	-0.002	-0.002	0.001	0.001	0.001	0.023*	0.023*	0.023*
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.010)	(0.010)	(0.010)
Slack resources	-0.000	-0.000	-0.000	-0.001*	-0.001*	-0.001*	0.006**	0.006**	0.006**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Pre-crisis stock price	-0.011**	-0.011**	-0.011**	-0.004.	-0.004.	-0.004.	-0.021***	-0.021***	-0.021***
	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.006)	(0.006)	(0.006)
Constant	0.037.	0.033*	0.029*	0.105***	0.103***	0.101***	0.013	0.001	-0.011
	(0.020)	(0.017)	(0.014)	(0.013)	(0.011)	(0.009)	(0.044)	(0.035)	(0.028)
Industry dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included
Observations	774	774	774	774	774	774	774	774	774
Adjusted R^2	0.201	0.201	0.201	0.143	0.143	0.143	0.226	0.226	0.226
Residual Std. Error (df = 704)	0.111	0.111	0.111	0.076	0.076	0.076	0.233	0.233	0.233
F Statistic (df = 69; 704)	3.817***	3.817***	3.817***	2.876***	2.876***	2.876***	4.280***	4.280***	4.280***

Note: Values are presented as B (SE) unless noted otherwise; Standard errors are robust; Numeric variables have been centered and standardized
*** p < 0.001, ** p < 0.01, * p < 0.05, . p < 0.1

DISCUSSION

By combining the dimensions of EO, crisis resilience, and financial leverage, our study contributes to both academic and managerial knowledge. We showed that EO firms are able to better cope with macroeconomic, adverse events while financial leverage even strengthens this positive relationship.

Research-related implications

We contribute to academic research at the interface of EO, crisis resilience, and financial leverage in three ways. First, we are pioneers in linking EO to crises. While EO is abundantly covered by many researchers and has been applied in various contexts – typically in relation to (financial) performance – the EO-crisis link has not yet received significant academic attention (Rauch et al., 2009). This is surprising for two reasons: on the one hand, because the number of and temporal proximity between recent recessions is notable (e.g., dot-com bubble (2000), 9/11 attacks (2001), Great Financial Crisis (2008), and the COVID-19 pandemic (since 2020) to only name the strongest, global ones). As such, organizations are likely to experience a major downturn every decade and would highly benefit from academic advice on how to best leverage their acquired EO capabilities. On the other hand, environmental and economic characteristics differ significantly between in-crises times and periods of stable business (Mobarek, Muradoglu, Mollah, & Hou, 2016). As such, we consider it valuable to explicitly not generalize findings from EO-performance relationships but instead, specifically adjust hypothesis, methodology, and interpretation to the specifics of systemic shocks.

Second, we introduce financial leverage as a new moderator for EO. According to Rauch et al. (2009), established EO moderators include business size (Covin & Slevin, 1989), industry type, or culture (Kreiser, Marino, & Weaver, 2002); a moderation through financial leverage has not yet received fundamental consideration. In addition, our interpretation of financial leverage differs from previous standard practice. Typically, the measure of financial leverage is

used to evaluate different capital structures, i.e., the balance between equity and debt finance. In our study, however, we go beyond this interpretation and make use of the indirect effects, such as additional stakeholder engagement and risk mitigation. These indirect effects contribute not only a correcting, compensating, or softening character, which balances the negative characteristics of an overly ambitious EO but even amplifies the EO-resilience relationship.

Third and last, we enrich EO research by using an event study approach. So far, researchers have predominantly analyzed EO with traditional regression models for which performance-related measures (e.g., revenue, profit, Tobin's q, market value, market share) served as dependent variables (Rauch et al., 2009). Our paper is among the few which introduce cumulative abnormal returns – i.e., the output of an event study – as the regressand. A natural advantage of this approach is the short, few-day measurement period. The brief time frame reduces the likelihood that confounding events could potentially influence statistical results (MacKinlay, 1997; McWilliams & Siegel, 1997). Given EO's power to influence all strategic decisions, operational practices, and management actions, we see high value in excluding the risk of confounding effects as much as possible (Covin, Green, & Slevin, 2006). With our study, we are able to demonstrate that EO research and event study methodology harmonize.

Managerial implications

Besides an academic contribution, we put forward three recommendations to a company's management team. First, we raise CxOs' awareness of the relevance of crisis preparation, specifically for systemic ones. Even though CxOs can rely on broad academic and literature support for crisis management (Hernantes, Rich, Laugé, Labaka, & Sarriegi, 2013), we urge leadership teams to specifically focus on mitigating actions for systemic crises. In difference to company-specific crises, systemic ones cannot be avoided by individual players; instead, at maximum, a company can encounter macroeconomic shocks with comprehensive preparation. Our findings suggest that companies can establish practices that have a dual benefit; EO is such a one.

Previous research found a strong, positive relationship between EO and performance (Lumpkin & Dess, 2001); we were able to show a strong, positive relationship between EO and crisis resilience. Hence, we advise management teams to verify whether they can revise, adjust or extend their strategic orientation to a more entrepreneurial one in order to secure benefits both in stable times as well as in periods of distress.

Second, we raise CxOs' awareness that the generally desirable characteristics of EO can turn into negative ones if an EO-building strategy is too ambitious. In the sense of a *too much of a good thing* pitfall, companies that score extremely high on EO are prone to become too autonomous, lavish, proactive, competitive, or risk-taking (Hoffmann et al., 2018; Langfred, 2004). Even though our study suggests that mitigating influences are valuable in terms of crisis resilience, we cannot give exact advice on which levels of EO are still sustainable and which levels are not anymore. Hence, we encourage management teams to verify whether their current or planned level of EO is predominantly beneficial, and – if not – take corrective actions.

Third and last, we raise CxOs' awareness that balancing influences can add value – not only but also in times of distress. Our study exemplifies that financial leverage can contribute additional perspectives, skills, and interests when making decisions. Financial leverage's inherent function is comparable to consensual decision-making, in which contrasting opinions lead to a middle ground with a generally superior outcome (Andersen & Jaeger, 1999). Ideally, the balancing counterpart takes the position of a sparring partner on eye level, so that this very counterpart has a stake in the company but is at the same time not too influential. Having a stake in the company is beneficial as this guarantees that the counterpart has a personal interest in the company's prosperity. However, if the counterpart is too powerful, he would solely focus on his individual agenda leaving the organization's interests apart.

Limitations and avenues for future research

Even though our research is based on a solid conceptual background and appropriate methodology, we have to acknowledge a set of limitations that at the same time guide future research. We reflect our thoughts in three sections: limitations related to the dependent variable (CAR), limitations related to the independent variable (EO), and limitations related to concept and interpretation.

First, we face limitations related to the dependent variable (CAR). The exact configuration of our event study influences the regressand, i.e., CAR. Even though event date, event window length, reference index, and type of data adjustments have been chosen carefully and with sufficient theoretical backing, we could not test every single scenario. Instead, we verified select combinations in both our principal regression analysis and for robustness checks. Based on the results, we do not have any doubts about our analysis' correctness but suggest that other researchers broaden statistical work. Options for potential adjustments range from picking alternative event dates over examining additional event windows to changing the type of data adjustment (Kliger & Gurevich, 2014). Further, fellow researchers may investigate alternatives to the stock-price-based approach. Even though "stock prices [are said to be] among the best measures available to assess resilience in general crises" (DesJardine et al., 2019: 1457), stock market measures contain some restrictions, e.g., only listed firms are considered, stock price development represents an aggregate of several factors that cannot be completely disaggregated or isolated through control variables, and stock prices underlie supply-and-demand mechanics (Harper, 2021).

Second, we face limitations related to the dependent variable (EO). While the concept of EO is highly substantiated by prior research (Rauch et al., 2009), we cannot neglect natural restrictions of the measure's composition. The textual analysis of the MD&A chapter bases on a simple word-count procedure and does not semantically interpret the written text. As such, we are missing nuances and connotations in the language (Columbia University, 2019). Further,

the management summary section is only sparsely regulated in terms of content. While presented facts and figures are verified by external auditors, the MD&A section is not audited and hence presents the subjective perspectives of the management team (Hargrave, 2020). While we expect that each leadership team will display its company's current situation as positively as possible, some reports are written more accurately or swayed than others. Accordingly, we motivate researchers to evaluate alternative measures that influence crisis resilience (Linnenluecke, 2017).

Third and last, we face limitations related to concept and interpretation. As described by Brand and Jax (2007), resilience is a theoretic concept whose level of achievement cannot be measured directly. While DesJardine et al. (2019) and Sajko et al. (2020) decided to measure crisis resilience based on severity of loss and time to recovery, we opted for cumulative abnormal returns. Accordingly, we see a benefit in expanding this highly quantitative concept to a qualitative one. As such, we highly recommend fellow researchers to set up a methodology that bases on surveys, questionnaires, and interviews.

Moreover, we operationalize our moderation through a debt-to-asset measure, i.e., financial leverage. Originally this measure reflects a company's capital structure (Antzoulatos, Koufopoulos, Lambrinoudakis, & Tsiritakis, 2016) but is only seldomly interpreted as a mitigating or balancing factor as we did. As such, we encourage fellow researchers to identify and test alternative measures that allow for the same interpretation.

In sum, we suggest two avenues for future research: on the one hand, we see value in deepening knowledge about the application of our dependent and independent variable in the context of an event study, on the other hand, we see value in broadening the concept of resilience by directing research toward qualitative measures and introducing alternative measures for our moderator variable.

CONCLUSION

Our research shows that the interaction between EO and crisis resilience is not a linear, one-dimensional relationship. We successfully confirmed that CxOs can increase crisis resilience through a thorough EO focus and proved that the positive associations are even stronger if firms are financially leveraged. Our interpretation attributes a range of positive characteristics to debt finance, among others a temperate investment strategy and a modest level of proactivity. We explain our findings in light of the contingency theory and human capital theory and extend academic literature at the interface of EO, crisis management, and financial leverage. Given that our study is one of the first to investigate the EO-resilience relationship, we firmly advise fellow researchers to expand on qualitative variables to measure resilience and on alternative measures for our moderator variable.

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Research study III

MANUAL TRANSMISSION: CONVINCE STAKEHOLDERS OF INNOVATION ACTIVITIES THROUGH WORDS, INVESTMENTS, AND RESULTS

ABSTRACT

In today's world of an ever-changing environment, it is essential to remain innovative, in particular for established, traditional companies. However, being innovative is worthless if innovation activities are not adequately communicated to key stakeholders. We ran a cluster analysis and investigated how innovation communication and conviction through words, investments, and results can drive economic value. Our results suggest four types of innovation-communication characters: unostentatious, silent, multiloquent, and factual innovators, each with a specific conviction pattern. Linking these four archetypes to a crisis-related measure, we found that benefits are largest for communication characters that sharply communicate either through words or through numbers. We base our research on S&P 1500 companies and observe crisis resilience in light of the 2008 Great Financial Crisis.

INTRODUCTION

According to a current BCG study, "innovation creates value, but too few companies are ready to drive real [benefits] from the innovation investments" (Manly, Baeza, & Ringel, 2021). The authors underline their findings by stating that a portfolio of the 50 most innovative companies outperforms the MSCI World Index by 3.3 percentage points per year when looking at total shareholder return. We considered this observation a starting point to investigate how innovation activities can transform into value and specifically focus on the transmission aspect, i.e., communicating to and convincing stakeholders.

The benefits of innovation are manifold and extensively discussed in academic literature (Bigliardi, Ferraro, Filippelli, & Galati, 2020; Mendoza-Silva, 2021). For the sake of this exploratory study, we lightly touch upon prior work, also in acknowledgment of the research stream's diversity. Many authors found empirical proof that product and process innovation have their individual merits (Damanpour, 2010; Dodgson, Gann, & Salter, 2002; Frishammar, Kurkkio, Abrahamsson, & Lichtenthaler, 2012; Hollen, van den Bosch, & Volberda, 2013), and, when combined, unleash even larger performance gains (Raymond & St-Pierre, 2010; Rousseau, Blake, Madden, & Crook, 2016). This positive innovation-performance relationship does, however, not hold in any situation (Rosenbusch, Brinckmann, & Bausch, 2011). McGee, Dowling, and Megginson (1995: 566), for example, found that "performance was, in general, negatively associated with one type of cooperative strategy, namely contracting for R&D, sales, or service." More recently, we see research tapping into the area of eco-innovation (Hizarci-Payne, İpek, & Kurt Gümüş, 2021) and innovation's role in unstable environments (Lv, Tian, Wei, & Xi, 2018). To create a link to our research, we briefly answer the question of why innovation is essential for business success and refer to three statements presented by Purcell (2019).

First, innovation helps companies grow. Innovative companies find it easier to generate additional revenues from new products or services or to adapt their current business model to collect additional income (Mikhalkina & Cabantous, 2015; Trapp, Voigt, & Brem, 2018).

Besides growing the top line, innovative companies can also focus on process improvements such that production becomes more efficient (Fouad, Tourabi, & Lakhnati, 2018; Ichimura, Ishii, Tuominen, & Piippo, 2003; Veldman & Gaalman, 2014). Typically, both initiatives, i.e., revenue and efficiency increase, will lead to additional profits so that innovative companies can expand their business, both organically and inorganically. Second, innovation keeps organizations relevant. In today's times of an ever-changing environment, companies need to constantly meet new realities. Long-term changes, i.e., megatrends, refer to climate change, digitization, demographic transition, shifts in economic and political powers, and a transformation of the energy market (Beinhocker, Davis, & Mendoca, 2009; Krys & Born, 2020; PWC, 2021). Short-term changes, i.e., the COVID-19 pandemic and the Russian attacks on Ukraine, motivate economies and companies to rethink their business model, sourcing strategy, and product offering within days (Simchi-Levi & Haren, 2022; Swanson, 2022). While start-ups use these disruptions to break into new industries, established firms need to be highly innovative to defend against competition and remain relevant in times of uncertainty. Third, innovation helps organizations differentiate. In essence, innovation means doing things differently. Especially in traditional, highly saturated industries or markets, finding new ways of defending a market position is essential (Mifli, Hashim, & Zainal, 2017; Ooi & Husted, 2021; Žižka, Valentová, Pelloneová, & Štichhauerová, 2018) – simply because sticking to the status quo does not work. Hence, delivering more value to customers will help stand out, build brand awareness and survive in the long run (Azad & Allahyari, 2017; Hanzaee & Yazd, 2010).

However, the above characteristics do not unfold automatically but are dependent on stakeholder actions. Authorities, customers, employees, investors, suppliers, and many more have to recognize and, even more important, appreciate a company's innovation effort such that a firm's innovation activities turn into economic value (Gelders, Galetzka, Verckens, & Seydel, 2008; Nutsugah, Anning-Dorson, Braimah, & Tweneboah-Koduah, 2021; Remme & Waal, 2020). Examples of stakeholders' contribution to firm success are manifold and include

authorities who give faster regulatory approvals, customers who spread the word about new products and services, employees who feel more attracted to job offerings, investors who are more generous in their investment decisions, and suppliers who offer better payment and delivery terms. Overall, a positive public perception appears to be beneficial (Goryachev, 2018). Companies can trigger and steer these recognition and appreciation processes through a thorough communication and conviction strategy (Nieminen, 2021). As such, innovative organizations should actively tell and explain how their innovation activities transform into stakeholder benefits. Hence, we can conclude that innovation communication is as important as innovation creation (Ackermann, 2013).

TRANSMISSION OF INNOVATION EFFORTS AND ACHIEVEMENTS

In our study, we focus on three methods to transmit innovation efforts and achievements: transmission through words, transmission through investments, and transmission through results.

First, the strategy to transmit innovation efforts and achievements through words allows for giving context (Nordquist, 2020). If companies decide to verbally comment on their innovation activities, they can set individual focal points, refer to both the past and the future, and easily link different measures with one another. Moreover, verbal statements enable firms to include corrective comments and give reasons for their actions (Bradley, 2014; Chevallier, 2019). At the same time, textual communication allows for misguiding the audience easily, such that authors stress favorable and omit unfavorable developments. We refer to communication through words as *innovation spotlight* and operationalize the measure through a textual analysis of companies' annual reports.

Second, the strategy to transmit innovation efforts and achievements through investments allows for showing dedication (Luoma, 2010). If companies decide to present R&D expense data to underline their innovative strength, they focus on financials – more specific financial input. A clear, over-average monetary investment is a strong indicator of innovation dedication as investors can easily recognize the level of engagement – in particular, if data is compared to historic figures or industry averages (Strauß, 2021; Thomas & Paul, 2019). Given financial reporting standards and the requirement of financial audits, investment data is highly credible (SEC, 2020). A clear downside of communication through investments is the absence of context, as the measure is reduced to a number only and cannot provide any link to innovation results (Lungu & Baluna, 2021). Hence, when communicating through investments, it remains unclear whether or not the financial input ends in beneficial innovation output. We refer to communication through investments as *R&D stock* and operationalize the measure through a multi-year aggregation of research and development expense data.

Third, the strategy to transmit innovation efforts and achievements through results allows for stating success (Mellon, Palko, Lingel, Cincotta, Amidor, & Chen, 2016). If companies decide to refer to the outcomes of the innovation process, they stress their ability to create something new and differentiate from the competition (Johnson, 2012; Kranjcec, 2019). The result measure is, at least in this study, the variable with the highest market proximity. Again, it is easily interpretable, comparable to historic data and industry averages, but does not give any context or reasoning (Mintz, 1969; Warren & Sorescu, 2017). A downside of this measure refers to the fact that it does not take into account how many resources, e.g., time and money, were needed to achieve the result; as such, overall financial viability is ignored. We refer to communication through results as *patent stock* and operationalize the measure through a multi-year aggregation of patent count data.

We do not expect that any of the three communication and conviction methods are generally superior or inferior but see value in a better understanding of whether certain communication and conviction measures are typically combined. Central to this exploratory study is the expectation that each company is somehow innovative in its own respects. We run a cluster analysis and, due to the exploratory characteristic, refrain from formulating explicit hypotheses. Instead, we enrich the cluster analysis's result with a cross-tabularization of organizational resilience variables, each stating a different aspect of successful crisis management. As such, we link the communication and conviction approach with the innovation goal of staying relevant in times of an ever-changing environment (Purcell, 2019) – may it be the long-term megatrends or the short-term COVID-19 pandemic and the Russian attacks on Ukraine.

As described in detail in our previous research, the variable stock price loss can be interpreted as organizational stability and is short-term focused (DesJardine, Bansal, & Yang, 2019; Huesker, 2021); the variable time to recovery can be interpreted as organizational stability and is long-term focused (DesJardine et al., 2019); and the variable cumulative abnormal return (CAR) is event-study based and hence ultra-short-term focused (Huesker, 2022).

METHODOLOGY

The methodology partly resembles the prior work of Huesker (2021) and is equally applied to this study. To keep this study comprehensive, select paragraphs and decisions are repeated to ensure methodological consistency.

Our cluster analysis is based on a sample of companies listed on the S&P 1500 as of September 16, 2008; this date represents the day before the outbreak of the Great Financial Crisis (DesJardine et al., 2019; Sajko, Boone, & Buyl, 2020). Due to limited data availability of our core variables, i.e., innovation spotlight, R&D stock, and patent stock, observations of only 335 out of 1,500 companies enter our statistical analyses. We described the construction of our core measures in our prior research (Huesker, 2021, 2022) and hence only briefly repeat the composition in this context.

Innovation spotlight equals the innovation sub-dimension of Short, Broberg, Cogliser, and Brigham's (2010) Entrepreneurial orientation (EO) construct. Each EO sub-dimension bases on a textual analysis of companies' 2003-to-2007 annual reports. The measure is expressed as the ratio of trigger words divided by the total number of words. As such, we can interpret the variable as a percentage. R&D stock, referred to as *innovation input - quantity* in Huesker (2021), is the capitalization of yearly R&D expenses based on a declining-balance formula with constant depreciation. We measured the variable across the 2003-to-2007-time span and applied a log(1+x) transformation. We retrieved the underlying data from Compustat. Patent stock, referred to as *innovation output - quantity* in Huesker (2021), is constructed in the same way but with yearly patent count as the relevant metric. We retrieved the underlying data from the United States Patent and Trademark Office (USPTO). Unless stated otherwise, we centered and standardized our core variables to ensure comparability (Brusco, Singh, Cradit, & Steinley, 2017) and winsorized the data at the conservative 1% / 99% level to reduce the influence of outliers (Salkind, 2010).

We defined our supplementary variables as follows: *stock price loss*, referred to as *severity of loss* in Huesker (2021), relates to the absolute percentage of stock price drop in the 12 months following the start of the GFC (Great Financial Crisis); *time to recovery* relates to the number of days until a stock price reached its pre-GFC level; *cumulative abnormal return (CAR)* relates to the sum of daily abnormal returns for a 10-day event window around the starting date of the GFC. Where applicable, the relevant time frame equals the 2003-to-2007 period. We did not pursue any manual data adjustments and ran several cross-checks to ensure data integrity.

A cluster analysis is exploratory in nature and aims at arranging observations such that those with similar characteristics are grouped together. More specifically, the clustering algorithm calculates the distances between individual data points and eventually suggests a solution for which differences are minimized (Hahmann, Volk, Rosenthal, Habich, & Lehner, 2009). Cluster analyses are highly flexible as distance calculations and analysis methods can be specified in multiple ways. For distances, we used Euclidean as default and ran alternative calculations, e.g., Manhattan, Canberra, or Minkowski, for robustness and consistency checks. For analysis methods, we used K-means as default and ran alternative methods, e.g., ward.D, ward.D2, McQuitty, or centroid, for robustness and consistency checks.

We approached our cluster analysis from multiple directions and considered both hierarchical and non-hierarchical methods (Blashfield & Aldenderfer, 1978). The hierarchical method seeks to construct a top-down hierarchy of groups such that similar observations are placed in identical or nearby branches. The method's principal advantage is that it does not require a prespecified number of clusters. Instead, the algorithm arranges all observations in the form of a Dendrogram (i.e., a tree diagram) and allows researchers to flexibly determine the number of clusters in the aftermath. In contrast, the non-hierarchical method forms new clusters by refining, i.e., splitting or merging, existing clusters such that prespecified evaluation criteria are met (Giordani, Ferraro, & Martella, 2020). The method's principal advantage is its iterative

concept. To find an optimal solution, the algorithm continuously assigns observations to different clusters such that within-cluster homogeneity and between-cluster heterogeneity are maximized (Ketchen & Shook, 1996). However, the most relevant challenge of this method is the requirement to determine the resulting number of clusters in advance. We approached this problem in two ways. First, we visually inspected the K-means knee plot and determined the point at which the graph shows a significant change in slope. This very point equals the number of optimal clusters. This technique is also known as the elbow method. Second, we ran an automated analysis of 30 different indices to identify the optimal number of clusters. The algorithm varies all combinations of number of clusters, distance measures, and clustering methods to finally propose an optimal number of clusters according to the majority rule. The analysis is implemented in the R package *NbClust* administrated by Charrad, Ghazzali, Boiteau, and Niknafs (2014).

RESULTS

We present the results of our cluster analysis in two steps. We start with a descriptive overview of our core and supplementary variables. Then, we focus on the outcomes of the non-hierarchical cluster analysis and enrich our findings with relevant visualizations.

A descriptive overview and a correlation matrix of our core cluster and supplementary variables are presented in Table 1. Values for sample size, mean and standard deviation are generally inconspicuous. Nevertheless, we must acknowledge two missing observations (i.e., 0.6%) in our supplementary variables, which we treat as non-material. More importantly, we need to review the correlation of 0.67 between R&D stock and Patent stock which we also observed and already examined in our prior research (Huesker, 2021). In indifference to our earlier study, we can take a more relaxed approach this time, as cluster analyses lose relevance only for extreme correlations, i.e., those of 0.90 and higher (Sambandam, 2003). Anyhow, we need to bear in mind that the given correlation may lead to results for which within-cluster differences between the two variables are close to zero.

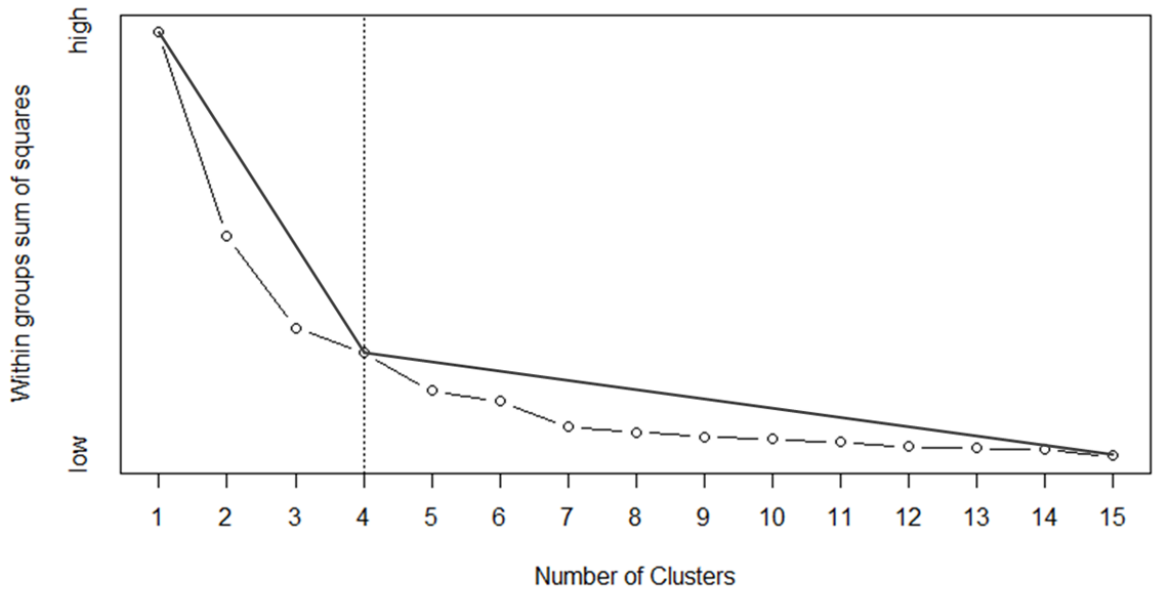
Table 1: Descriptives and correlation matrix of core cluster and supplementary variables

	Variable	n	Mean	SD	1	2	3	4	5
Core cluster variables									
1	Innovation spotlight	335	0.37	0.11					
2	R&D stock	335	884.28	2225.63	0.13				
3	Patent stock	335	211.59	489.66	0.10	0.67			
Supplementary variables									
4	Stock price loss	333	0.54	0.19	-0.18	-0.16	-0.10		
5	Time to recovery	301	522.65	388.97	-0.02	-0.01	-0.03	0.34	
6	CAR	333	-0.03	0.12	0.08	0.08	0.08	-0.20	-0.11

Notes: Variables are not standardized; missing observations in time to recovery variable indicate that these companies did not recover within the 5-year observation window; correlations higher than ±0.13 are significant at the $p < 0.05$ level
Abbreviations: CAR = Cumulative abnormal returns; SD = Standard deviation

To determine the optimal number of clusters for our non-hierarchical analysis, we first applied the elbow method and deduced that four clusters are reasonable (see Figure 1).

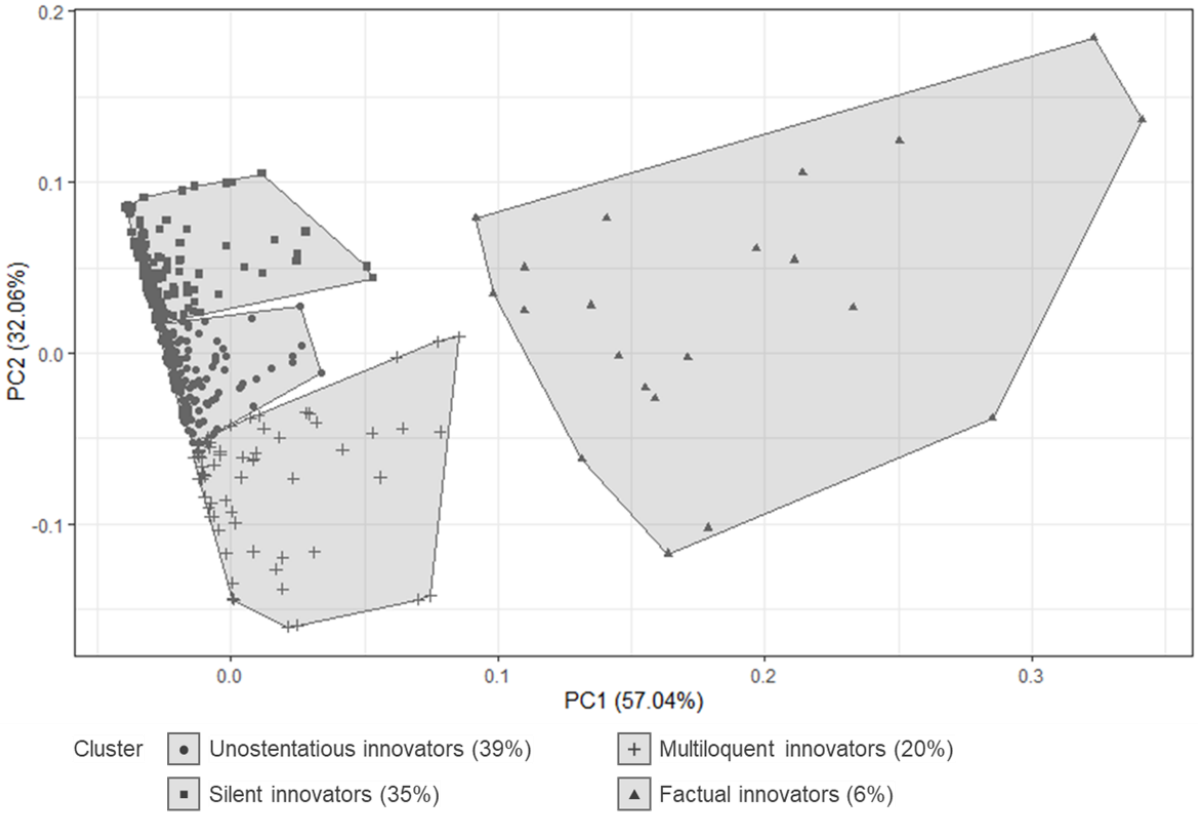
Figure 1: Optimal number of clusters determined by the elbow method



Source: own illustration

We second confirmed this result by a bulk analysis of indices which suggests specifying between two and five clusters depending on model parameters (Charrad et al., 2014). We last visualized the cluster composition in the form of a biplot and found strong support for splitting the data into four clusters, as the areas are clearly separated from each other (Figure 2). To conclude, specifying four clusters for our statistical analyses appears to be justifiable.

Figure 2: Cluster biplot by functional clusters



Note: percentage figures as total share, N = 335
Source: own illustration

The results of our cluster analysis are shown in Table 2. The distribution of cluster sizes, i.e., the number of observations contained in each cluster, is well balanced, with even the smallest cluster still representing 6% of observations. For each cluster, we can identify one extreme value, e.g., for the functional cluster of silent innovators, innovation spotlight is particularly low, for the functional cluster of factual innovators, R&D stock is remarkably high. As discussed earlier on, we need to carefully consider the effects of the strong correlation between R&D stock and patent stock; our findings are heterogenous: while the within-cluster difference for the functional cluster (1) and (2) are negligibly small (i.e., 0.03 and 0.01), deltas for the functional clusters (3) and (4) are notable (i.e., 0.15 and 0.24).

Table 2: Overview of cluster analysis results presented as means

Functional cluster	(1) **Unostentatious innovators**	(2) **Silent innovators**	(3) **Multiloquent innovators**	(4) **Factual innovators**
Observations (n)	131	117	66	21
Observations (%)	39%	35%	20%	6%
Innovation spotlight	0.13 *average*	-1.00 *low*	1.36 *high*	0.48 *average*
R&D stock	-0.26 *average*	-0.23 *average*	-0.11 *average*	3.22 *very high*
Patent stock	-0.29 *average*	-0.24 *average*	0.04 *average*	2.98 *high*

Notes: shown figures for cluster variables are the means per group; verbal descriptions are derived from a five-step scale (very low, low, average, high, very high) matching the 1, 2, and 3 standard deviation spacing; variables are standardized
Abbreviations: R&D = Research and development

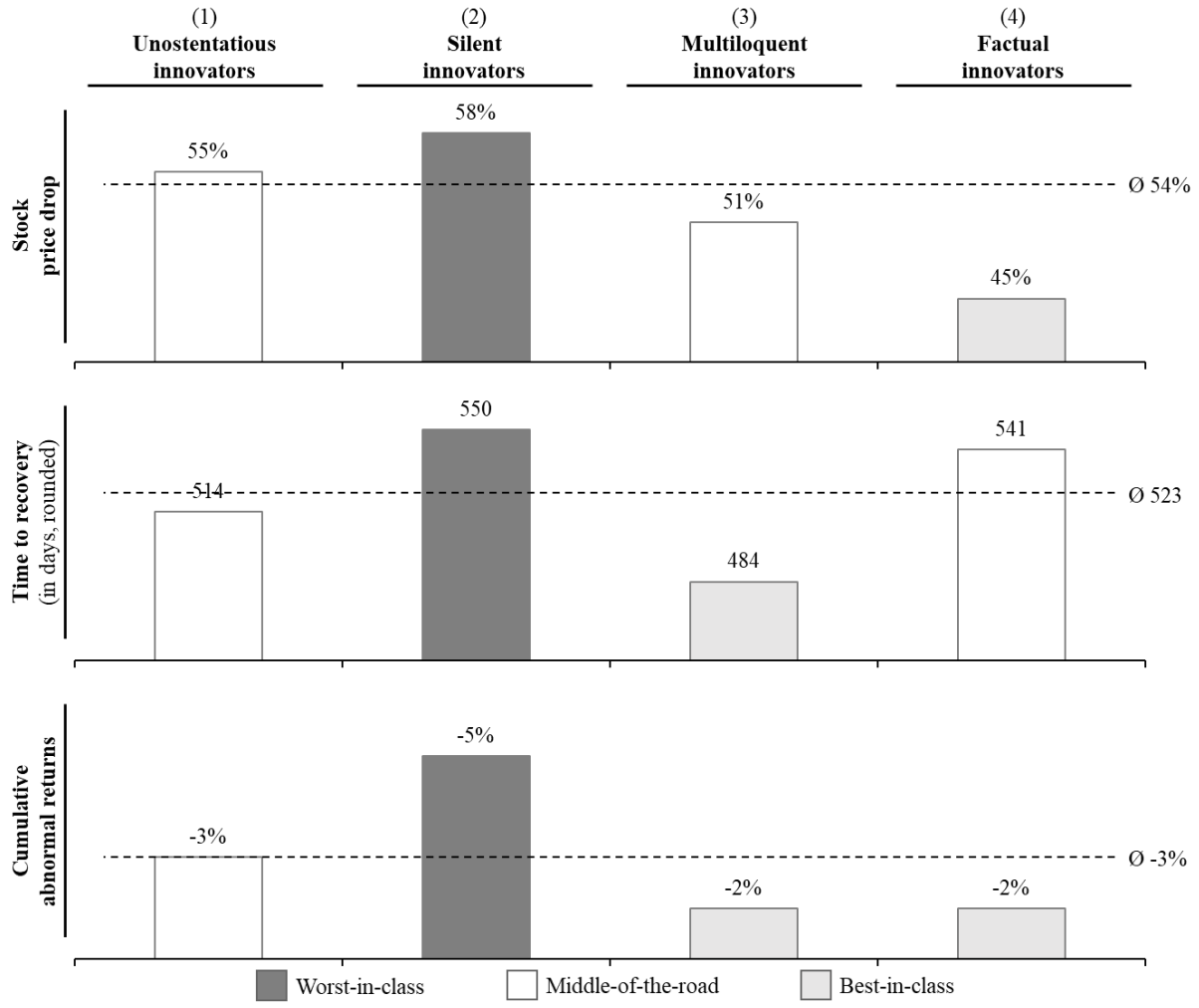
We finally present the results for the cross-tabulation of functional clusters and supplementary variables representing different dimensions of crisis resilience in Table 3 and Figure 3. Without anticipating the detailed interpretation, we can already state that silent innovators show inferior performance across all three dimensions, while multiloquent innovators and factual innovators are equally strong, with superior performance in two out of three dimensions. The differences between worst-in-class and best-in-class performance are notable.

Table 3: Overview of cluster analysis results presented as means

Functional cluster	(1) **Unostentatious innovators**	(2) **Silent innovators**	(3) **Multiloquent innovators**	(4) **Factual innovators**
Stock price loss	0.55	0.58	0.51	0.45
Time to recovery	514.44	549.95	484.19	541.29
CAR	-0.03	-0.05	-0.02	-0.02

Notes: variables are not standardized; Stock price loss and CAR can be interpreted as a % figure; Time to recovery is shown in days
Abbreviations: CAR = Cumulative abnormal returns

Figure 3: Mean crisis resilience by functional clusters



Source: own illustration

A MULTICOLORED WORLD OF INNOVATION COMMUNICATION

Building on the high-level results presented in the preceding chapter, we see value in investigating similarities and differences between the four clusters as well as their relationships to characteristics of crisis resilience, represented by the three supplementary variables. As such, we refer to the previously introduced concept of how companies convince external parties of their innovative strength, i.e., convincing through words, investments, and results. As introduced earlier, this choice is statistically captured by the variables innovation spotlight, R&D stock, and patent stock respectively. We refer to the four clusters as (1) unostentatious innovators, (2) silent innovators, (3) multiloquent innovators, and (4) factual innovators.

Unostentatious innovators (n = 131, 39%) transmit their innovation efforts slightly stronger through words ($\mu = 0.13$) than through investments ($\mu = -0.26$) and results ($\mu = -0.29$). Overall, their engagement level is just average. Firms represented in this cluster are unobtrusive, decent, or discreet when presenting themselves to external parties. As such, their innovation communication pattern appears to be unfocused. This cluster contains, among others, companies such as Colgate-Palmolive (producing, distributing, and providing consumer products), Lexmark (manufacturing printers and imaging products), and Netgear (producing networking hardware for B2B and B2C clients). Rather than imputing that unostentatious innovators are non-innovative, we put forward the idea that for these companies spreading innovation achievements through official communication channels is less important than through its consumers. A potential concept unostentatious innovators may rely on is word-of-mouth communication (Pfeffermann, Minshall, & Mortara, 2013), which is particularly beneficial if companies exceed product expectations, provide superior customer service, and inform customers exclusively (Hayes, 2021). Anecdotally, EngagementLabs (2016) attribute such a strategy to the cluster member Colgate-Palmolive.

Silent innovators (n = 117, 35%) transmit their innovation efforts neither through words ($\mu = -1.00$) nor through investments ($\mu = -0.23$) and results ($\mu = -0.24$). Conviction levels across

all three dimensions are at maximum *average*, by tendency even below. These results are surprising in two ways: first, this cluster is remarkable large; second, this cluster contains popular companies such as Amazon (selling all sorts of physical goods and offering IT services), Hasbro (inventing and producing toys and board games as well as owning media assets), and Raytheon (researching, developing and manufacturing aerospace, defense, and information security products and services). We assume that not only these exemplary firms but also other companies in this cluster show their innovative strength through a medium not captured in this analysis, e.g. through unique features and characteristics of their products and services (Pfeffermann et al., 2013). By equipping products with the latest technology, as for example Amazon does with its eBook reader Kindle, firms can directly manifest that their innovation efforts result in concrete benefits for their customers (Rubin, 2017).

Multiloquent innovators (n = 66, 20%) transmit their innovation efforts primarily through words ($\mu = 1.36$), and to a lesser extent through investments ($\mu = -0.11$) and results ($\mu = 0.04$). Companies represented in this cluster are talkative, voluble, and expressive. They use annual reports to inform external parties about their innovation activities, while neither R&D expense figures nor numbers of granted patents strengthen their statements. Since our cluster analysis cannot provide an answer to the question how credible and effective companies' assertions are, we suggest that external parties should carefully evaluate whether multiloquent innovators are truly innovative or whether they just engage in innovation window-dressing (Allen, 2012). This cluster contains, among others, companies such as Adobe (providing software for graphics, animation, and videos), Electronic Arts (publishing computer games for personal computers and game consoles), and Nvidia (designing graphics processing units for gaming and professional markets). While we understand that software products, such as those offered by Adobe and Electronic Arts, can hardly be patented (Adams, 2020), we had at least expected an over-average, i.e., positive, level of R&D stock. However, numerous researchers, e.g., Everse (2011) and Simmons (2015), strongly argue that communication with a comprehensive

story, as easily realizable in annual reports' MD&A sections, is particularly strong and convincing.

Factual innovators (n = 21, 6%) transmit their innovation efforts partly through words ($\mu = 0.48$) but much stronger through investments ($\mu = 3.22$) and results ($\mu = 2.98$). Companies represented in this cluster convince through facts, they appear to have an affinity for numbers and can prove their track record by referring to audited, public data (SEC, 2020; USPTO, 2017). As such, they prefer to use the space in their annual reports for topics not directly linked to innovation themes. Interestingly, this cluster is the smallest but contains only large and relevant American companies (i.e., all 21 companies are part of the S&P 500). Firm examples are Du Pont (producing chemicals), Merck (researching, producing, and marketing pharmaceuticals), and Microsoft (providing computer software and cloud services). It is worth noting that Microsoft, as a software company, managed to show high levels of R&D stock (5.99) and patent stock (6.04), while its peers, e.g., Adobe (0.35; 1.12) and Electronic Arts (1.12; -0.40), both categorized as multiloquent innovators, show significant lower metrics in these two dimensions. Literature provides support that communicating with facts and figures is, even though not in isolation, highly beneficial when it comes to presenting financially relevant achievements (Damodaran, 2017; Pluye & Hong, 2014).

BENEFITS TO THOSE WHO PURPOSEFULLY ACT

While the four functional clusters only explain which approach companies use to transmit their innovation messages, we seek to identify whether any of these conviction methods are superior or inferior for mitigating the effects of external shocks. As explained earlier, we do so by cross-tabularizing the functional clusters with the three variables representing crisis resilience. Table 3 and Figure 3 present our findings. Figure 3 is designed such that shorter columns represent a higher degree of crisis resilience, i.e., stock prices drop less, time to recovery is shorter, and cumulative abnormal returns are less negative. We distinguish between three findings.

First, being mute hurts. Companies in the silent innovators' cluster show the worst performance across all three crisis resilience measures. Compared to overall averages, silent innovators' stock prices drop by four percentage points more, their stocks take 27 days longer to recover, and equity prices generate a two percentage point higher short-term loss at crisis outbreak. Existing literature supports our findings. Kalogiannidis (2020: 1) states that "organizations that are so deficient in their means of communication rarely achieve greater performance as those that possess high levels of effective business communication." Reasons for the relative underperformance of silent companies include a defective relationship between the organizations and their different external stakeholders, e.g., customers, business partners, and investors (Al-Tokhais, 2016), a lack of confidence in employees resulting in productivity losses (Bernstein, 2017), and missing guidance from company's management team due to unformulated mission statements (Ateş, Tarakci, Porck, van Knippenberg, & Groenen, 2020). Especially in times of systemic distress, in which economies, governments, businesses, and individuals are in ample need of leadership, non-communication is particularly harmful (Ecklebe & Löffler, 2021; Nijkrake, Gosselt, & Gutteling, 2015; Zoeteman, Kersten, Vos, van Voort, & Ale, 2010).

Second, being unobtrusive doesn't help. Companies in the unostentatious innovators' cluster show an average performance across all of the three supplementary measures. Absolute deviations between overall averages and cluster-specific means are low (one percentage point for

stock price loss; eight days for time to recovery (not rounded), and no deviation for cumulative abnormal returns). In essence, an unaimed, or more positively expressed ordinary innovation communication strategy does have limited benefits, i.e., a higher crisis resilience than those who are silent, but it is still not a solid protection against crisis consequences. James Clear, the author of the #1 New York Times bestseller "Atomic Habits", commented on such mediocre endeavors with "Don't put in average effort and claim that you want exceptional results" (Clear, 2019). His quote is in line with academic studies from a wide variety of research domains. As such, Tramontin Castanha, Beuren, and Gasparetto (2020) found that communication intensity is positively correlated to employee engagement and task performance, which we, in turn, consider the basis for overall business success. Hence, an average innovation communication intensity will only yield average performance benefits. The same has been found for a mediocre intangible asset strategy (Shakina & Barajas, 2016). Further, from Chung, Animesh, Han, and Pinsonneault (2020) study on firms' social media activities, we deduce that those with a more coherent social media strategy show a better market performance. The authors empirically analyzed companies' volume of public social media posts and the timeliness of responses to customers' messages. Last, Nutsugah et al. (2021) found that the direct effect between environmental performance and financial performance is negatively associated, while the mediation by integrated marketing communication turns the relationship into a positive one. From this, we conclude that not only action, in our case being innovative, but also the according communication plays a vital role for external perception. Overall, we see sufficient support for our findings that a middle-of-the-road, non-focused, or mediocre attitude to innovation communication can hardly have sustainable, positive effects on crisis resilience.

Third, being active makes you win. Companies in the multiloquent innovators' and factual innovators' cluster show best-in-class performance in two out of three resilience dimensions. While both undercut the cumulative abnormal returns average by one percentage point, superior performances in the stock price drop and time to recovery measures are mixed: factual

innovators experience a lower stock price drop (-9 percentage points compared to the average), whereas multiloquent innovators recover significantly faster (39 days quicker than the average). We explain this contrast by focusing on how the innovation messages are transmitted (Table 4).

Table 4: Characteristics of communication methods

#	**Dimension**	Communication and conviction by…		
		Words	**Investments**	**Results**
1	Output credibility	acceptable	high	
2	Output comparability	cumbersome	easy	
3	Data availability	acceptable	high	
4	Time focus	retro- and prospective	retrospective	
5	Fit for automated analysis	acceptable	high	
6	Time requirement for analysis	high	low	
7	Comprehensiveness	high	low	
8	Understandability	acceptable	high	

Source: own illustration

Innovation communication by facts and figures (i.e., investments and results), as applied in our study, comprises a specific set of characteristics: factual arguments (1) have a high degree of credibility due to their external origin or official audits (SEC, 2002), (2) allow for easy year-on-year and peer comparisons as data is uniformly calculated and aggregated into one figure each, (3) are freely available and easily accessible through structured databases (Refinitiv, 2021), (4) have a retrospective time focus only, (5) are well suited for automated analysis through simple calculus, (6) require only little time and computational capacity for evaluation, (7) are not very comprehensive as they are merely numbers, and (8) can be well interpreted irrespective of analysts' language skills or cultural backgrounds (Guedj, 1997). All of these allow external stakeholders in general and financial investors in specific to compute and assess a firm's innovation activities in a quick and reliable, but only retrospective manner. Accordingly, stakeholders receive results rapidly, and their derived actions materialize quickly. This short-term focus matches the near-term characteristic of the stock price drop variable, determined by the lowest stock price in the 12 months following the crisis outbreak and interpreted

as a measure of stability (DesJardine et al., 2019; Sajko et al., 2020). Long-term benefits can, however, hardly be captured by numeric messages. The downside of their narrow and retrospective view hinders stakeholders from predicting long-term, future development as context, vision, and expected actions cannot be transferred by numbers alone.

In contrast, innovation communication and conviction by words, as applied in our study, comprise a different set of characteristics. Verbal expressions (1) have only an acceptable level of credibility, as statements are just reviewed instead of audited (Hargrave, 2020), (2) are cumbersome to compare as style and focus differ from year to year and from company to company, (3) are freely available in online repositories but are technically more difficult to access (Rflugum, 2018), (4) may be both prospective and retrospective, (5) can be analyzed by complex software algorithms but (6) require more time and IT capacity to complete (Muslu, Radhakrishnan, Subramanyam, & Lim, 2015), (7) are quite comprehensive as they allow to also transmit nuances and hidden messages but are at the same time more prone for manipulation, and (8) can only be reasonably interpreted if recipients are equipped with a superior level of language skills in order to detect manipulation and read between the lines. All of these allow external stakeholders in general and financial investors in specific to compute and assess a firm's innovation activities in a more detailed, comprehensive, and also forward-looking manner such that results and suggested actions are long-term oriented. This long-term orientation matches the long-term characteristic of the time to recovery variable, determined by the time a stock price takes to recover to its pre-crisis level and interpreted as a measure of flexibility (DesJardine et al., 2019; Sajko et al., 2020). As a complete analysis, interpretation, and viability check of verbal innovation messages take time, we are not surprised that benefits do not materialize in the short term.

To conclude this subchapter, we see that a high degree of innovation communication and conviction helps to show a greater level of crisis resilience. The way how these messages are transmitted, i.e., either through numbers and figures, as factual innovators do, or through

words, as multiloquent investors do, is linked to whether a company exhibits higher stability or flexibility after times of distress.

LIMITATIONS AND AVENUES FOR FUTURE RESEARCH

Due to the explorative nature of cluster analyses, we need to constitute important limitations that could be transformed into and addressed by future research. As such, we would like to refer to the topics of literature review, innovation measurement, communication methods, statistical analysis, and practical relevance.

First, we need to acknowledge that our introduction and analysis do not base on an exhaustive literature review, but on a summary of the most relevant studies. Reasons for staying on a high level include the explorative nature of this study, i.e., we preferred to avoid excessive guidance by prior research, and certainly the challenge that both innovation as well as communication literature is so vast in size that a complete analysis would have been beyond the scope of this study. We advise fellow researchers to consider all the loose ends this study leaves as a starting point for further investigation.

Second, our innovation measures turned out to be less rich and diverse than initially expected. The high correlation between R&D stock and patent stock may reduce the expressiveness and specificity of the clusters analysis. As seen in Table 2, values for R&D stock and patent stock are particularly similar for the (1) unostentatious innovators and (2) silent innovators. If we had more innovation measures, both the number of and difference between clusters could have become sharper and more distinct. We advise fellow researchers to consider the following, non-exhaustive list of additional or alternative measures for innovation: number of product releases, revenue or profit with new products (or services), size of the product pipeline (measured as count or value), or number of employees (or FTE) working for innovation projects.

Third, in line with the number of innovation measures, we limited our study to communication and conviction with words, investments, and results. However, as already noted in the prior chapters, there are additional ways in which companies can transmit their innovation messages. Examples include through word-to-mouth, a proxy for less controllable channels,

through their products and services, through visuals, and maybe more experimental, through sounds. All of the aforementioned objects can serve for further investigation.

Fourth, a downside of cluster analyses is their lack of statistical robustness, especially when compared to alternatives such as event studies, regression, or survival models. While cluster analyses do, however, have their right to exist, more complex statistical tests are likely to generate further insights. Accordingly, we recommend fellow researchers to build on our explorative findings and analyze them with advanced statistical techniques. Methods described in our previous papers can provide guidance (Huesker, 2021, 2022).

Fifth and last, we acknowledge that our work is theoretical in nature and could benefit from practical testing. Even though we inferred the described relationship from trustable, tested data and are confident that our findings have practical value, we expect additional insights if our results were verified with primary research, e.g., through surveys and interviews.

To conclude, even though our study contains topics that could be improved, we primarily consider the above-mentioned limitations as interesting avenues for further exploration. To prioritize the above collection, we suggest first extending the list of input variables to generate broader and more differentiated cluster analysis results.

CONCLUSION AND IMPLICATIONS

Summing up our cluster analysis, we can generate three messages that not only spark academic interest but also have a practical use for management teams. First, develop an awareness that communicating your innovation efforts to external parties is as vital as pursuing the innovation itself. We found that there is no benefit in setting up and executing a prime innovation strategy if no one receives and understands the intentions. Second, decide on how you want to transmit your innovation efforts. We take the position that there is no superior or inferior communication or conviction method, if anything, each method has its right to exist. This paper focused on three potential methods, namely words, investments, and results, and additionally touched upon word-to-mouth and product/service-related means. Ultimately, we suggest choosing the preferred way according to company-specific goals and business model. Third, mind the implications of your choice from a receiver's perspective. We learned that communication by words has fundamentally different characteristics than communication by numbers and found that the earlier fits the long-term, the latter the short-term perspective.

We are confident that we contributed managerial knowledge that helps companies to not only create innovation value but to actually drive real benefits from the innovation investments, as demanded by the BCG Study on the Most Innovative Companies 2021 (Manly et al., 2021).

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