Journal of Behavioral Economics for Policy, Vol. 4, COVID-19 Special Issue 3, 55-65, 2020

Rationally bounded in a storm of complex events: Small businesses facing natural hazard resilience during a pandemic

Jennifer F. Helgeson[1]*, Juan F. Fung[1], Alfredo R. Roa-Henriquez[1, 2]

Abstract
High-level economic estimates of disaster events typically report upon direct losses and do not capture indirect and longer-term impacts. In turn, these indirect and longer-term losses map to vulnerabilities that limit the decision sets available to agents seeking to manage current and future disruptive events, especially when these events are complex in nature. Herein we introduce the importance of considering agents' learning, agency, and flexibility (LAF) when providing support (financial and in-kind) aimed to enable agents to increase resilience capacity. Examples are drawn from a national survey conducted by agencies in the U.S. Department of Commerce (DOC) to better understand decision-making of owners and managers of micro-, small-, and medium-sized enterprises (MSMEs) faced with natural disasters and other concerns in the context of COVID-19. Little has been written from a behavioral economics perspective about MSMEs even though impacts on MSMEs have important implications given their critical role in the economy. Initial findings from this survey support the claim that LAF are key attributes of resilience capacity, especially relevant when considering complex events.

JEL Classification: D700; D810; D830

Keywords
agency — business resilience — flexibility — learning — Micro-, Small-, and Medium-sized Enterprises (MSMEs)

[1] *Applied Economics Office (AEO), National Institute of Standards and Technology (NIST), USA*
[2] *Johns Hopkins University*
***Corresponding author**: jennifer.helgeson@nist.gov

Introduction

In the first nine months of 2020 the United States experienced 16 natural disaster events with losses exceeding $1B each, making "2020 the sixth consecutive year (2015-2020) with ten or more billion-dollar weather and climate disaster events" (NOAA, 2020). The total cost to the U.S. of the COVID-19 pandemic has been estimated to exceed $16T (Cutler & Summers, 2020). Ultimately the extent to which losses are incurred (and reduced) relates back to individual or group decision-making. And these decisions are made within spatial and temporal frames that are deeply uncertain. High-level economic estimates of disaster events typically report upon direct losses and do not capture indirect and longer-term impacts. In turn, these indirect and longer-term losses map to vulnerabilities that limit the decision sets available to agents seeking to manage current and future disruptive events, especially when they are complex in nature.

Proactive investments in resilience are an important and increasingly cost-effective strategy for mitigating the impacts of weather and climate disasters (FEMA, 2019). Recently there has been increased discussion about understanding and managing connected extreme events (e.g., Raymond et al., 2020). Some scholars use the term *adaptive risk management* to describe the process of learning from experience and adjusting management in response to new information (e.g., Hurlbert et al., 2019). Businesses need to integrate extreme events, especially those that are low-probability, high-impact, into their enterprise risk management (ERM) processes. However, ERM is not meant to prevent all business risks nor is it a prescriptive method for managing individual risks (Beasley et al., 2019). Furthermore, small businesses struggle to allocate otherwise productive resources towards preparing for events that are unlikely to occur.

In economic modeling the main difference between decisions made under risk and decisions under uncertainty is that the former allow us to model the variable of interest according to a specific probability distribution whereas we do not have this knowledge in the latter type of decisions. Studies considering biases, beliefs, heuristics, and values increasingly recognize that decisions under uncertainty are not synonymous with decisions made under risk (Mousavi & Gigerenzer, 2014); however, this has not been well addressed in the research space of disaster resilience planning and associated recovery. Additionally, there is little written about bounded rationality and adaptative learning when agents face complex events arising from cascading or compound risks, especially when there is high uncertainty around impact levels

and the length of time of the perturbance is highly ambiguous, such as in the case of the COVID-19 transmission and recovery period(s). Under such circumstances, otherwise rational decision-making may be bounded by depleted access to resources – both financial and nonfinancial – due to the unexpected emergence of complex events and path dependence incurred through decision-making.

This paper introduces the method of considering agents' learning, agency, and flexibility (LAF) when providing support (financial and in-kind) aimed to enable agents to increase resilience. Examples are drawn from decision-making of owners and managers of micro-, small-, and medium-sized enterprises (MSMEs)[1] faced with natural disasters in the context of COVID-19. MSMEs are a critical sector for which choice sets were immediately reduced during the COVID-19 pandemic due to: *limited customer interactions, reduced employee availability, and disruptions in supply chains.*

This paper is organized as follows. Section 2 introduces the concept of complex event resilience and presents the method of considering LAF in policies and assistance offered to address complex event resilience. Section 3 discusses concepts introduced in the context of MSME survival amid complex events, specifically natural hazards during COVID-19. This section presents initial findings from a survey of owners/managers of U.S. MSMEs, specifically complex event concerns and self-identified needs that fall within the LAF categories. Section 4 summarizes lessons learned and suggests areas for continued research.

Complex event resilience

Researchers and practitioners have long advocated for multi-hazard planning solutions and the value of anticipatory adaptation (e.g., Grimm, 2013; Linnenluecke et al., 2012; Sahebjamnia et al., 2015; Spillan & Hough, 2003). This section describes a taxonomy of disturbance types that may be considered in development of resilience-based policies and introduces the importance of considering learning, agency, and flexibility when assessing an agent's resilience capacity to complex events over time.

Disaster risk types

Resilience in general terms addresses the capacity of an entity (e.g., individual, institution, community, or society) potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of function and structure (Carlson et al., 2012). Complex events can result from multiple hazards, often through a multifarious combination of natural (e.g., hurricanes), biological (i.e., pandemic), and/or human-made (terrorism) causes. Pescaroli & Alexander (2018) propose a holistic framework that highlights the complementarities of four risk types (i.e., compound, interacting, interconnected and cascading risks). Herein, complex events precipitated by compound and/or cascading risks are of interest.[2]

Chronic events are recurring and often can be expected; they may include events such as seasonal flooding and the influenza season.[3] Acute events are associated with less predictable hazard events that generally occur infrequently.[4] Covariate events directly affect entities in a given geographic region, while idiosyncratic events affect specific entities within a community.[5] Though covariate events may be experienced broadly by a community, they may still be highly localized (e.g., depth of flooding at a given MSME post-hurricane). It remains unclear the extent to which COVID-19 is a covariate or idiosyncratic ; it has impacted the global landscape; however, impacts and experiences of the pandemic vary greatly across regions and individuals, e.g., due to background wellbeing circumstances or localized infection rates. Thus, with COVID-19 we are all in similar storms, but very different boats, which in turn affects how we perceive the *storm* for ourselves and others. For additional discussion of covariate/idiosyncratic and acute/chronic shocks and stresses relevant to MSMEs, see Helgeson et al. (2020).

Given a disturbance circumstance, an agent's resilience capacity is a function of exposure, sensitivity, and adaptive capacity; see Figure 1. And the recovery trajectory is dependent upon the response(s) made by the agent. However, in the context of complex events, the ability to respond is altered by the uncertainty and/or novelty of the complexity. For example, response choices towards pandemic circumstances may curtail possible response towards a natural hazard that occurs concurrently to create a complex event. Adaptive pathways are frequently discussed at the community level in the context of risks and response options to climate change under different socio-economic futures and development prospects (e.g., Cradock-Henry et al., 2018). Yet, similar discussions at the agent-level (i.e., individual or institution) are critical to better understand decisions that appear to be the product of bounded rationality, but are likely determined through path dependency.

Resilience capacity: learning, agency, and flexibility

The relationship between attitudes and behavior has been a major topic of investigation in social psychology (e.g., Eagly & Chaiken, 1993) and the best-known model of the relationship is the Theory of Reasoned Action (Fishbein & Ajzen, 1975)

[1] Here we take MSMEs to employ 250 or fewer people at a single site; micro-sized establishments to have ten or fewer employees.

[2] Concurrent risks are taken to be a subset of compound risks.

[3] A chronic risk is one that is recurring, can often be expected, and for which an MSME may plan for regularly. Chronic natural disaster risks include drought, extreme cold, heat waves, winter storms, flooding. Acute risks are associated with less predictability and are often defined by low-probability and high-impact. Acute natural disaster risks include hurricanes, storm surge, earthquakes, tsunamis, tornadoes, and wildfires.

[4] In some literature acute events are referred to as shocks (e.g., Marques, 2003; Kozel et al., 2008) and chronic events are referred to as stressors; however, in this framing, chronic events can manifest as a series of shocks that cause long-term stress(es).

[5] Here community is defined as spatially proximate.

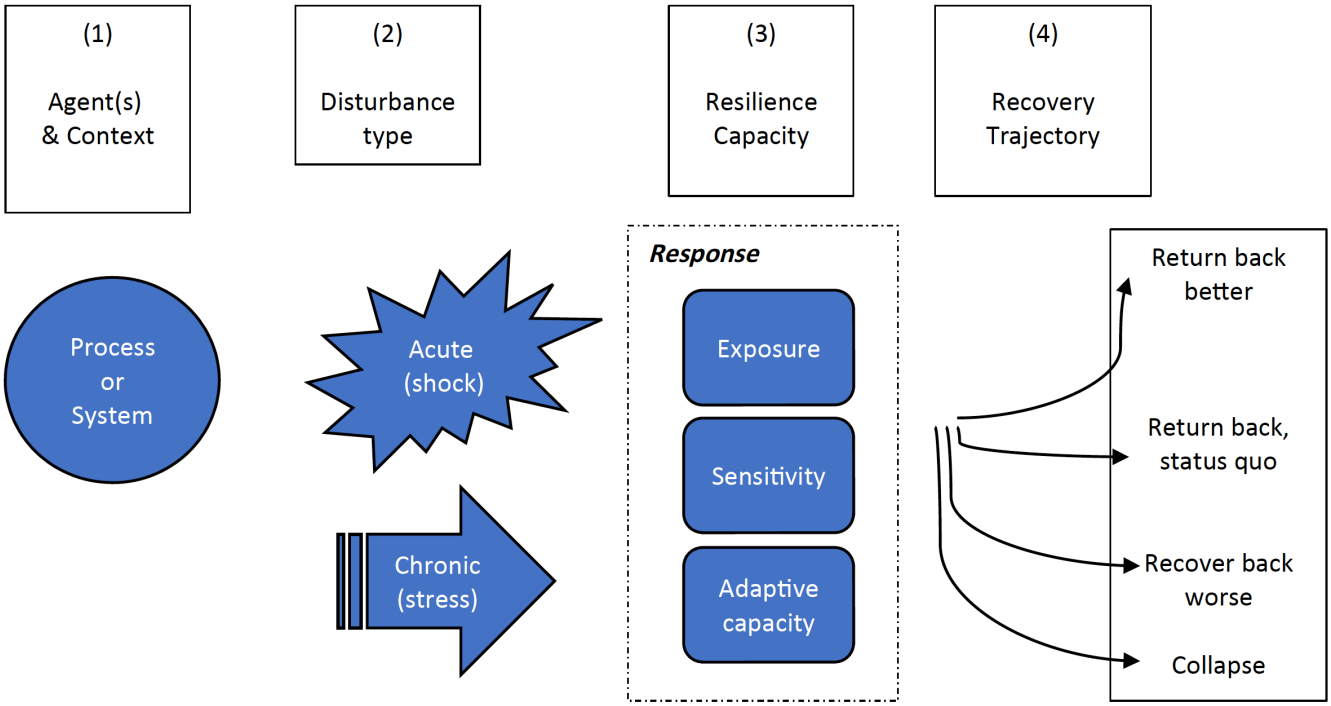

Figure 1. Schematic presentation of factors relevant to the resilience curve trajectory.

and its elaboration in the Theory of Planned Behavior (Ajzen, 1991). In this framework, attitudes and subjective norms about a behavior (as well as perceived behavioral control) influence behavioral intentions which, in turn, determine the likelihood of the behavior occurring. However, what occurs when behavioral intentions that would otherwise be actualized are disturbed by highly uncertain circumstances and extreme bounding of the expected behavioral option set? Agents may appear to make choices that are bounded in rationality, but are actually bounded by their evolving objective ability to take on the intended behavior and to meet an objective function that is meaningful in the context of the complex event in question.

For example, a typical metric for business recovery across disruptive event types tends to be employment and revenue (e.g., Sanchis et al., 2020). However, in the context of a hurricane, an MSME owner may be concerned about ensuring minimal physical damage to the business location, while during COVID-19 the medium-term objective may be to ensure that staff do not contract COVID-19. These actions will likely result in steady revenue generated; however, macroeconomic policies may miss something by looking at revenue or employment in isolation.

Thus, those providing assistance would benefit from awareness of how an agent responds to various assistance options. The response, which is a function of learning, agency, and flexibility, ultimately shapes the agency's capacity for resilience and path dependency as how these choices are presented is critical. It is acknowledged that knowledge is often associated with the agent's perception of risk, which in turn is influenced by cognitive, subconscious, socio-cultural and other factors (e.g., Helgeson et al., 2012). However, the goal here is to suggest meaningful categories that are tractable for those designing and providing assistance in the context of complex events. Learning, agency, and flexibility (LAF) are attributes that impact an agent's resilience capacity to disaster circumstances (Figure 2) that can be meaningfully assessed and can be applied across groups (e.g., businesses, households) and contexts.

1. **Learning:** Learning after a disaster can build adaptive capacity as individuals, groups, or businesses are able to make informed decisions before, during, and after the next event (Tuler et al., 2017). Brody (2003) integrated learning with adaptive management to study hazard plans over time. Other authors argue for more formalized adaptation pathways or strategies that can occur after an extreme weather event that triggers action (Arnell & Delaney, 2006; Berkhout et al., 2006; Hoffmann et al., 2009; Luthe & Wyss, 2015; Willows & Connell, 2003); these concepts apply across disaster types. In a complex event setting, learning is moderated by the capacity to manage and the capacity to reorganize. The capacity to manage refers to maximization of potential activities and output – at all times and under all conditions. What constitutes these activities and output may differ largely across agents. The capacity to reorganize relates to the concepts of single- and double-loop learning. Mitzberg (1994) notes that "[managers have] a mental model of the world in which

they act based on experience and knowledge" which is the hallmark of single loop learning. When an agent can acquire and integrate new information and experiences to apply to additional contexts via double-loop learning their capacity to reorganize is increased.

2. **Agency:** There has been little written about agency in disaster resilience, although there is a robust general literature on the topic of agency through perceived control. Here agency refers to "a process encompassing iterative, projective, and practical evaluative dimensions which unfold in relation to the temporal and structural context within which situated learning is embedded"(Kakavelakis & Edwards, 2012). In a complex event setting, agency is moderated by the choice option set and access to choices. The choice option set is the potential set of options that may be accessed by the agent, while access to choices is reflective of the *actual* choice set facing the agent. For example, an SME may have a choice option set that includes access to the Paycheck Protection Program (PPP); however, if not approved for the PPP, the SME's access to choices is limited.

3. **Flexibility:** Flexibility refers to the ease with which an agent can apply changes in order to suit different conditions. It is a theme throughout emergency management literature, which stresses the ability to improvise when addressing resilience (e.g., Dynes, 1994; Harrald, 2006). In a complex event setting, flexibility is moderated by range of movement and the willingness to change. Range of movement is the capacity to move towards the choice option set that is available to the agent. For example, even if approved for the program, to access a PPP loan, the MSME must be flexible enough to potentially fulfill the medium-term requirements of the program (e.g., maintain employees). Furthermore, willingness to change or adjust ultimately determines the extent of flexibility taken relative to the objective range of movement.

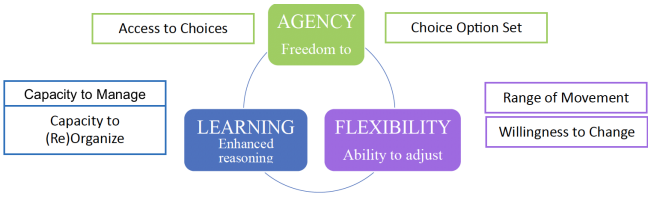

Figure 2. Learning, agency, and flexibility (LAF) attributes impact an agent's resilience capacity under disaster circumstances. Applicable to both singular and complex event types.

Decision-makers under bounded rationality act as satisficers, seeking a satisfactory solution rather than an optimal one. In the context of disaster resilience and complex event resilience, in particular, rationality may be bounded by the strength and direction of the LAF vector defined by the combination of the agent's learning, agency, and flexibility. Ideally, an agent's LAF may be considered as a *stock option* where extra is paid now in return for having the potential to adapt in the future should conditions require. The value of this LAF vector can increase in line with the level of future uncertainty. Figure 3 illustrates the ideal recovery process of resilience moving from a period of recovery from one complex event to pre-event functioning in the next time period ahead of a subsequent event. This schematic assumes that the type of event in each period is similar and thus, familiar to the agent. This works well when applying lessons learned to a similar event and circumstances; however, with a high level of LAF and accompanying option set, a similar pathway may be possible. One way to think about this is illustrated in Figure 4, considering LAF impacts on an agent's management under different event types.

There is balance between opportunity and capacity when facing uncertain and complex event risks. In addressing complex events, agents face multiple risks with varying levels of uncertainty, but they have limited resources. Thus, the major question becomes how an agent allocates scarce resources across multiple competing objectives when some are less likely to come to fruition, (e.g., the idea of the COVID-19 pandemic in 2019), and require generous use of resources for the *just in case*. In turn, what actionable information and support might be provided on tradeoffs and mutual benefits between these multiple and highly uncertain objectives that are strongly path dependent?

Complex event management: Insights from small businesses

MSMEs in areas vulnerable to natural disasters are particularly noteworthy in the context of COVID-19 for two reasons. First, their path to recovery must not just be about how to recover from the pandemic, but also include adaptation and mitigation plans, that not only address public health concerns, but also brace for impending natural hazards. Second, effects from COVID-19 stand to exacerbate the lingering effects of past natural hazards and make continuing recovery increasingly difficult. Despite coping with uncertainty being a frequent theme in organizational theory (e.g., Pfeffer & Salancik, 1978; Aldrich, 1979; Cummings & Wilson, 2003), little research has been conducted into how managers from different types of organizations deal with the uncertainties created by the threat (and sometimes the actuality) of disaster events, much less complex events. Subsequently, policies may benefit from deeper insights and tractability of this information. Furthermore, MSMEs are critical because of their connections to both households in the form of labor and consumers (e.g., Watson et al., 2020).

MSME management of complex events

MSMEs make up 99.9% of U.S. businesses and employed 59 million people in 2018 (SBA, 2019). Estimates suggest

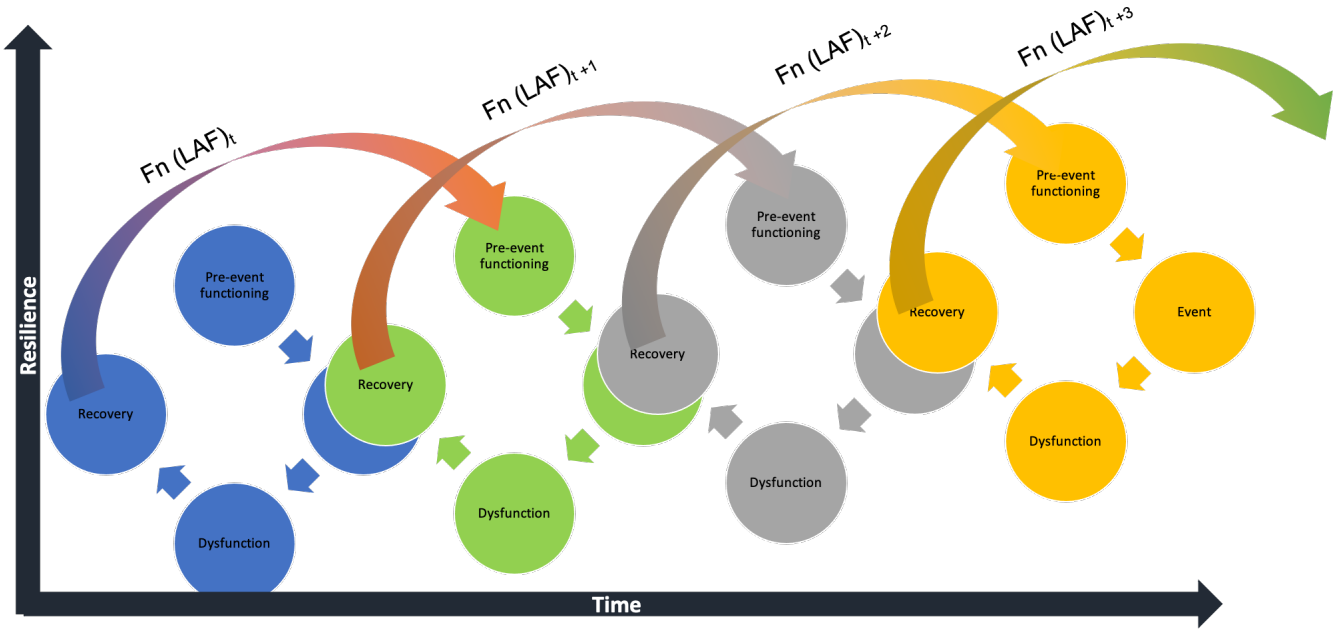

Figure 3. Ideal change from recovery to pre-event functioning across time. Adapted from Pierel (2020).

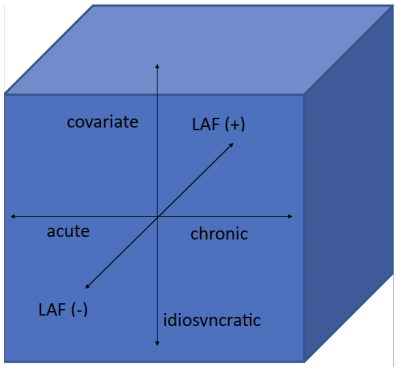

Figure 4. Learning, agency, and flexibility (LAF) attributes impact an agent's management under different event types.

that 7.5 million small businesses are in danger of closing permanently due to COVID-19 related difficulties (Powe and Wagner, 2020). To date 5.2 million Paycheck Protection Program (PPP) loans were distributed, worth $525 billion (SBA, 2020). However, in a recent macroeconomic analysis of the PPP, Chetty et al. (2020) suggest that the program increased employment at small businesses by only 2% at a cost of excess $300K per job saved. Furthermore, low-wage workers continue to experience greater job losses and cuts in nominal wages (Cajner et al., 2020). Early results suggest that "stimulating aggregate demand or providing liquidity to businesses… have diminished capacity to restore employment" (Chetty et al., 2020).

There were at least 18 major natural disaster declarations made between March 13, 2020 when the Federal State of Emergency for the COVID-19 pandemic was declared and September 2020.[6] These events likely impacted MSMEs' ability to open and adjust to pandemic circumstances. Furthermore, continued stressors on African-American-, Latinx-, Asian-, immigrant- and female-owned businesses may account for why they have been disproportionately impacted by COVID-19 (Fairlie, 2020; Fairlie & Robb, 2007).

Keeping MSMEs afloat is central to efforts to shore up the U.S. economy. Chetty et al. (2020) consider the macro view, but discerning the impact of natural hazard shocks and more persistent stressors is complicated. There have been many surveys addressing business experiences throughout the pandemic, including the U.S. Census PULSE survey[7] and others at local levels and via trade associations. In the majority of such surveys, the metrics of impact and recovery obtained tend to revolve around employment and revenue. Complex events do not appear to be addressed directly, and the concerns motivating decisions, as well as the mechanisms by which owners and managers are making such decisions, is largely absent. This is where addressing LAF may be valuable to move forward both local regulation and tweak the use of traditional macroeconomic tools to address MSMEs' ability to thrive, as opposed to acting as satisficers.

[6] For a complete list of Disaster Declarations, see: fema.gov/disasters/disaster-declarations.

[7] census.gov/data/experimental-data-products/household-pulse-survey.html

Survey of MSME complex event resilience

A U.S. Department of Commerce survey conducted in late summer 2020 was the first in a longitudinal study of business resilience in the face of complex events that arise from COVID-19 impacts in addition to other stressors and shocks experienced by U.S. businesses. Details of the survey methodology are outlined in Helgeson et al. (2020a) and initial results across the survey of 1374 MSME owners and managers nationally are reported in Helgeson et al. (2020b). The lessons learned from the survey, which included closed and open-ended questions, are intended to be relevant to MSME owners and managers; these lessons learned are also intended to assist entities that provide guidance to MSMEs on:

1. Mitigation planning for natural disasters during a pandemic situation and

2. Disaster readiness strategies to cope with the disruptions from a pandemic situation. Emergent themes from the survey reflected LAF as important in owner/manager ability to deal with complex events that arose from natural disasters and other events concurrent with the pandemic.

In the sections that follow we provide an overview of the survey and highlight key questions that indicate key trends consistent with the LAF framework. It should be noted that the survey reported upon in this paper was not designed to explicitly measure LAF and disentangling these concepts is not always straightforward.

Learning

A number of survey responses point towards the capacity to manage and the capacity to reorganize as critical to the MSME's ability to address complex events during COVID-19. In particular, experience appears to be tied to the ability to address complex events under COVID-19 conditions.

The majority of survey respondents indicated that their MSME has been affected by a natural disaster in the past ten years; see Figure 5 for the breakdown by U.S. Census region. Past experience with natural disasters is divided between chronic (13%) and acute (18%) events; 57% report having experienced both types in the past ten years (pre-COVID-19).

The survey asked respondents if actions taken to prepare for natural disasters in the past helped them prepare for or cope with the impacts of COVID-19: 24% indicated that disaster preparedness has helped them with COVID-19, while 56% said it has not, and 20% report being "unsure."[8] It is worth noting that 11% of respondents that had not experienced any type of natural disaster still found natural disaster preparedness helped reduce the impacts of COVID-19.

Financial difficulties arising from a number of direct and indirect COVID-19 specific impacts were frequently discussed

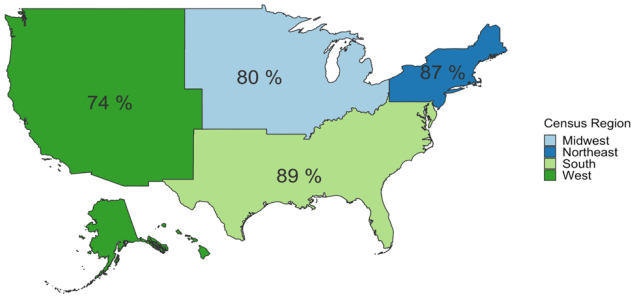

Figure 5. Fraction of respondents in each U.S. Census region that have been affected by some natural disaster in the past ten years. n=837.

by respondents. Many micro-sized enterprises expressed concerns over continuing to fund employee health insurance as financial margins continue to tighten. Those in the services sector, especially those seasonal in their functions, experienced delays from the consumer-side that supersede past delays from natural disaster impacts. This is largely accounted for by deep uncertainty facing consumers. In turn, respondents have been left with less of a financial safety net.

Assessment of the open-ended responses indicate that the capacity to manage is strongly tied to a commitment to meet specific objectives, such as keeping employees onboard and not cutting wages. Furthermore, the capacity to reorganize to address COVID-19 impacts based on the acquisition and integration of information learned from past actual hazard experience and even just the act of past planning without experiencing a natural hazard.

Agency

In regard to access to various forms of capital, the agency of MSME stakeholders is limited by the relatively sparse resources they have available to put towards resilience planning and recovery activities. Moreover, investments in resilience must be balanced with other business needs. Little research has been conducted to understand prioritization across potential mitigation and adaptation options, either individually or within the larger system of business needs (e.g., payroll, training, etc.), especially in the face of complex events.

The survey asked respondents if their MSME had experienced a natural disaster event since March 13th, 2020;2 29% indicated that they had experienced such an event.[9] Of these responses, 13% reported that their organizational response to the occurrence of natural disasters at their location had been affected by COVID-19.

MSMEs' capacity to respond to natural disasters is limited by current COVID-19 associated changes, even when they have extensive previous experience with past natural disasters,

[8] In addition, 156 respondents indicated that this the question did not apply to them and 338 did not answer the question.

[9] The period March 13-August 8, 2020. Natural disaster seasonality should be taken into account. Given the number of Presidentially declared natural disasters in August-September 2020, this value may underestimate disaster experience during the pandemic. n=1038

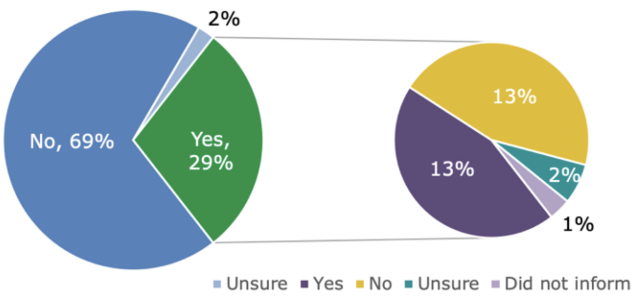

Figure 6. MSMEs affected by a natural disaster during COVID-19, left. n=1038. Of those affected, whether the response to the complex event was affected by COVID-19, right. N=300.

both acute and chronic. Most of this experience relates to actions, opposed to financial dispersion.

Even respondents who indicated no direct impact from COVID-19 on their natural disaster response indicated that they were indirectly affected by decisions the business had previously made to address COVID-19, indicating LAF path dependency to some extent. For example, in sectors where there had already been a significant shift towards teleworking to address COVID-19 already, it was easier to telework as a response to the natural disaster. Some businesses reporting minimal negative effects from COVID-19 indicated that experiencing a natural disaster during the pandemic disturbed what had become *new normal* operating procedures. Across sectors and designation of MSMEs as essential (or not), liquidity was a major issue. For example, there was concern around ability to meet the criteria for PPP loans when money earmarked for employee retention was used to address natural disaster recovery during this period.

As the COVID-19 transmission period persists, many respondents indicated that their sense of agency is increasingly limited, both via the potential choice option sets and their actual access to choices. In some cases respondents have chosen to work with other MSMEs to help increase collective agency; 25% of respondents opted to exchange resources or information with other organizations, and 8% of them implemented short-term alliances with their suppliers and/or competitors.

In open-ended questions when agency was limited, respondents often indicated that they would compensate by increasing flexibility, e.g., they would be willing to deplete personal liquidity above and beyond the business' liquidity.

Flexibility

Looking forward,[10] the survey asked respondents about their concerns regarding continued COVID-19 impacts on the recovery process. Of the 1006 responses to the question, 99% expressed concern over the risk of one or more complex event(s) occurring during the COVID-19 transmission and recovery period across the categories: natural disaster(s), COVID-19 specific, financial /market, workforce issues, consumer issues, and global concerns. Notably, those who have experienced or have prepared for natural disasters in the past more readily expressed concern over a complex event. Out of the 99% of MSMEs that expressed any concern, 31% reported specific concern over complex events related to occurrence of a natural disaster during the COVID-19 pandemic. Table 1 shows the breakdown by U.S. Census region and past natural disaster experience.

Of the concerns indicated in Table 1, 31% of respondents further indicated that they have the resources to protect their business against these expressed concerns, 37% indicated that they do not have the resources to allow them flexibility, and 32% of respondents are unsure. Figure 7 provides a word cloud of themes indicated by respondents to help them reduce concern over potential complex events during the COVID-19 period via increased range of movement.

Figure 7. Word cloud presentation of resources needed by businesses to reduce their concerns specific to other risks coming to fruition during the COVID-19 transmission period.

In general, respondents with a greater range of movement across coping and adaptation options available appear to be better prepared for unexpected disaster events, which is not unexpected. However, even when flexibility is severely bounded, if available strategies are general enough to transfer seamlessly from one event type (e.g., natural hazard) to another (e.g., COVID-19), appropriate levels of learning and agency were maintained. One such example is teleworking and curb-side pick-up.

Respondents largely indicated that they were unsure (44%) about how preparedness and response to future natural disasters will change as a consequence of COVID-19 experiences once the pandemic is over,[11] while 9% of respondents indi-

[10] This question was asked about the "future," opposed to events that may have already occurred. MSMEs that experienced a natural disaster during the COVID-19 pandemic up until the point of taking this survey did not necessarily indicate concern about a natural disaster in this forward looking question.

[11] n=629

Top concerns, by disaster experience and region	Midwest		Northeast		South		West	
	No	Yes	No	Yes	No	Yes	No	Yes
Natural Hazard Concerns	2%	8%	1%	5%	3%	63%	4%	15%
COVID-19 Specific Concerns	2%	10%	1%	11%	6%	48%	5%	17%
Business Financial, Market Concerns	2%	10%	1%	9%	6%	49%	6%	16%
Workforce Concerns	2%	11%	1%	9%	6%	51%	5%	16%
Consumer Concern	3%	10%	1%	9%	8%	48%	6%	15%
Global Concerns	3%	9%	1%	11%	6%	44%	5%	21%

Table 1. Percent of respondents indicating a complex event type as a top concern, grouped by Census region and experience with a recent natural disaster. n=938.

cated that their planning will change and 47% believed that it will not.

Additional survey insights

The survey asks respondents to indicate agreement with the statement: "COVID-19 posed the greatest risk yet to my organization's survival." Notably, 60% of those respondents indicating that they strongly agree with the statement have past natural disaster experience. The survey goes on to ask respondents to indicate agreement with the statement that "the impacts of COVID-19 will leave my organization unable to cope with a natural disaster, should one occur, in the next year." Notably, 90% of those who responded that they strongly agree have previous experience with natural disasters.

Many respondents indicated that deep uncertainty is the main source of concern; there is a desire for certainty in guidance and resources that will be made available to prepare for complex events. In open-ended responses the term "crystal ball" appeared frequently; for example: *"[I need] a crystal ball to tell [if] a further shut down will occur, reactions, and... the economic impacts."* Even those respondents who have seen an uptick in demand during COVID-19 hesitate to expand operations. Many respondents indicated that they are *unsure* about what resources they need to protect their MSME: *"I'm not sure what resources I need or that they even exist."*

Those respondents who provided information about resources to help them address complex risks in the future typically indicated that they need assistance that falls within the categories noted in Figure 8.

In facing potential complex events, MSMEs acknowledged the need to be financially prepared ahead of time. However, strengthening MSMEs' resilience capacity in the current environment is perceived as tricky at best. As one respondent noted: *"The cost of preparedness reduces margin and we were already a low margin business."* Some respondents hold business interruption insurance as a form of resilience planning for natural disasters. Many were unsuccessful when trying to file a claim for business interruption from a pandemic. These respondents are concerned about covering additional losses should a complex event occur. In considering finances, many MSMEs are interested in the potential for low interest special

Figure 8. MSME expressed needs, related to improved LAF.

loans to maintain businesses that are operating at reduced capacity already, while also needing to cover the cost of utilities, PPE, and salaries. There is also a desire to obtain training specific to financial resources, such as how to create better business relationships with financial institutions and lending personnel. Many respondents expressed gratitude for SBA assistance, but desire a better understanding of how to apply for grants and other income support moving forward.

Policy relevant summary and future research

Previous work on multi-hazard planning has generally focused on the existence of a plan; this focus has led to limited understanding of how hazard planning and past experience may influence outcomes of a novel disruptive experience. Provision of successful guidance would benefit from longitudinal assessment of an agent's learning, agency, and flexibility across disruptive event types. As extreme weather and other disaster events are occurring with greater frequency, duration, intensity, and uncertainty this is a critical step to demonstrate efficient and effective resilience measures.

Businesses need to adopt resilience strategies that include ambitious mitigation measures, as well as steps to strategically transform to benefit from new opportunities and address unprecedented risks. However, risk-based policymaking typically fits uneasily with adaptative management approaches to uncertainty.

Findings from the presented U.S. MSME survey are consistent with initial findings from Chetty et al. (2020) that find traditional macroeconomic tools may have diminishing returns when addressing complex event resilience, at least in the context of a pandemic. As the COVID-19 transmission period continues, MSMEs, households, and other entities will employ a variety of coping strategies, from reducing current consumption to disposing of productive assets largely through satisficing if needed. These latter strategies are especially worrisome, as they may reduce the capacity of the MSME to generate income in the future, possibly reducing their resilience. Greater understanding of learning, agency, and flexibility and striving to strengthen the LAF elements that apply widely across event types is critical. There may be negative effects from indirect and long-term impacts on reducing the choice set; however, there is also the possibility to keep explanding this set and access to different choices as long as the MSME improves its LAF.

Addressing MSMEs' expressed needs (Figure 8) through easy-to-access training and guidance may be a point of departure for increased LAF and subsequent increased resilience capacity at the individual MSME level. Furthermore, applications for aid and services by government and other entities that liaise directly with MSMEs may consider: 1. Inclusion of key principles from behavioral economics/economic psychology to supplement more typical metrics (e.g., number of employees and revenue) in applications and/or 2. Following-up with those granted assistance to better track development of LAF.

MSMEs do not exist in a vacuum. In most cases they are community assets and encouraging planning for complex events as a part of a community of MSMEs may be beneficial. There is some evidence that cooperation across MSMEs can strengthen collective adaptative capacity. Further exploration in this space is left for future work. Future efforts may also seek to better understand the institutional dynamics (e.g., across management and employees) of MSMEs as they relate to LAF.

Based on initial survey findings additional longitudinal survey efforts are planned to better understand the critical role these key factors play.

Acknowledgments

The authors wish to acknowledge the following individuals for their contributions to the survey reported upon and the themes introduced in this paper: David Butry (AEO, NIST), Claudia Nierenberg (National Oceanic and Atmospheric Association – NOAA), and Ariela Zycherman (NOAA).

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes, 50*(2): 179–211.

Aldrich, H. E. (1979). *Organizations and environments*. Englewood Cliffs, NJ: Prentice-Hall.

Arnell, N. W., & E. K. Delaney. (2006). Adapting to climate change: Public water supply in England and Wales. *Climatic Change, 78*(2): 227–255. doi: 10.1007/s10584-006-9067-9

Beasley, M.S., B.C. Branson, & B.V. Hancock. (2019). "An Overview of Enterprise Risk Management Practices 10th Anniversary Edition." erm.ncsu.edu/az/erm/i/chan/library/2019_Current_Report_on_State_of_Risk_Oversight.pdf

Berkhout, F., J. Hertin, & D.M. Gann, (2006). Learning to Adapt: Organisational Adaptation to Climate Change Impacts. *Climatic Change, 78*(1): 135–156. doi: 10.1007/s10584-006-9089-3

Brody, S. D. (2003). Are We Learning to Make Better Plans?: A Longitudinal Analysis of Plan Quality Associated with Natural Hazards. *Journal of Planning Education and Research, 23*(2): 191–201. doi: 10.1177/0739456X03258635

Cajner, T., L. Crane, R. Deckner, J. Grigsby, A. Hamins-Puertolas, E. Hurst, C. Kurtz, & A. Yildirmaz. (August 2020). "The U.S. Labor Market during the Beginning of the Pandemic Recession." *NBER Working Paper 27159*.

Carlson, L., G. Bessett, W. Buehring, M. Collins, S. Folga, B. Haffenden, F. Petit, J. Phillips, D. Verner, & R. Whitfield (2012). "Resilience: Theory and Applications." publications.anl.gov/anlpubs/2012/02/72218.pdf

Chetty, R., J. Friedman, N. Hendren, M. Stepner, et al. (November 2020). The Economic Impacts of COVID-19: Evidence from a New Public Database Built Using Private Sector Data. opportunityinsights.org/wp-content/uploads/2020/05/tracker_paper.pdf

Cummings, S., & D. Wilson (2003). *Images of Strategy*. Malden, MA: Blackwell Publishing.

Cutler D. M. & H. Summers (2020). The COVID-19 Pandemic and the $16 Trillion Virus. *JAMA, 324*(15): 1495–1496. doi: 10.1001/jama.2020.19759

Dynes, R. R. (1994). Community emergency planning: False assumptions and inappropriate analogies. *International Journal of Mass Emergencies and Disasters, 12*: 141–58.

Eagly, A. H. & S. Chaiken (1993). The psychology of attitudes. *Harcourt Brace Jovanovich College Publishers*.

Fairlie, A. & A. Robb. (2007). Why Are Black-Owned Businesses Less Successful than White- Owned Businesses? The Role of Families, Inheritances, and Business Human Capital. *Journal of Labor Economics, 25*(2) (April 2007): 289–323.

Fairlie, R. (2020). The Impact of Covid-19 on Small Business Owners: Evidence of Early-Stage Losses from the April 2020 Current Population Survey. *SIEPR Working Paper*, 20-022. siepr.stanford.edu/sites/default/files/publications/20-022.pdf

FEMA (2019). National Mitigation Investment Strategy. fema.gov/media-library-data/1565706308412-19739d7deeca639415cc76c681cee531/NationalMitigationInvestmentStrategy.pdf

Fishbein, M. & I. Ajzen (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Grimm, D. (2013). Whole community planning: Building resiliency at the local level. *Journal of Business Continuity & Emergency Planning, 7*(3): 253–259.

Harrald, J. R. (2006). Agility and Discipline: Critical Success Factors for Disaster Response. *Annals of the American Academy of Political and Social Science, 604*: 256-272.

Helgeson, J., S. van der Linden, & I. Chabay (2012). "The role of knowledge, learning and mental models in public perceptions of climate change related risks." In A. E. J. Wals (Ed.), *Learning for sustainability in times of accelerating change* (pp. 329–346). Wageningen Academic Publishers. doi: 10.3920/978-90-8686-757-8_21

Helgeson, J., J. F. Fung, Y. Zhang, A. Roa Henriquez, A. Zycherman, C. Nierenberg, D. Butry, D. Ramkissoon (2020a). Eliciting lessons from small- and medium-sized enterprises (SMEs) for natural disaster resilience planning and recovery during the COVID-19 pandemic: SME Complex Event Resilience. NIST DCI 002, Gaithersburg, MD. doi: 106028/NIST.DCI002

Helgeson, J., J. F. Fung, Y. Zhang, A. Roa Henriquez, A. Zycherman, C. Nierenberg, D. Butry, D. Ramkissoon (2020b). Complex Event Resilience of Small- and Medium-Sized Enterprises: Natural Disaster Planning During the COVID-19 Pandemic. NIST SP 1258, Gaithersburg, MD. doi: 106028/NIST.SP1258

Hoffmann, V. H., D. C. Sprengel, A. Ziegler, M. Kolb, & B. Abegg. (2009). Determinants of corporate adaptation to climate change in winter tourism: An econometric analysis. *Global Environmental Change, 19*(2): 256–264. doi: 10.1016/j.gloenvcha.2008.12.002

Hurlbert, M., J. Krishnaswamy, E. Davin, F.X. Johnson, C.F. Mena, J. Morton, S. Myeong, D. Viner, K. Warner, A. Wreford, S. Zakieldeen, & Z. Zommers (2019). "Risk Management and Decision making in Relation to Sustainable Development". In P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.), *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*.

Kakavelakis, K., & Edwards, T. (2012). Situated learning theory and agentic orientation. *Management Learning, 43*: 475–494.

Linnenluecke, M. K., A. Griffiths, & M. Winn (2012). Extreme weather events and the critical importance of anticipatory adaptation and organizational resilience in responding to impacts. *Business Strategy and the Environment, 21*(1): 17–32. doi: 10.1002/bse.70810.1002/bse.708

Luthe, T., & R. Wyss (2015). Introducing adaptive waves as a concept to inform mental models of resilience. *Sustainability Science, 10*(4): 673–685. doi: 10.1007/s11625-015-0316-6

Mintzberg, H. (1994). *The Rise and Fall of Strategic Planning: Reconceiving roles for planning, plans, and planners*. New York: The Free Press, P. 368.

Mousavi, S., & G. Gigerenzer (2014). Risk, uncertainty, and heuristics. *Journal of Business Research, 67*(8): 1671–1678.

NOAA (October 2020). "Billion-Dollar Weather and Climate Disasters: Overview." ncdc.noaa.gov/billions/

Pescaroli G., & D. Alexander (2018). Understanding Compound, Interconnected, Interacting, and Cascading Risks: A Holistic Framework. *Risk Anal*. 2018 Nov; 38(11): 2245-2257. doi: 10.1111/risa.13128. Epub 2018 Jun 15. PMID: 29906307.

Pfeffer, J., & G. Salancik (1978). *The External Control of Organizations: A Resource Dependence Perspective*. Harper & Row, New York.

Pierel, E. D. (2020). "Relating Resilience, Adaptation, and Learning." doi: 10.6084/m9.figshare.12783473.v1

Raymond, C., R. M. Horton, J. Zscheischler, et al. (2020). Understanding and managing connected extreme events. *Nature Climate Change, 10*: 611–621. doi: 10.1038/s41558-020-0790-4

Sahebjamnia, N., S. A. Torabi, & S. A. Mansouri (2015). Integrated business continuity and disaster recovery planning: Towards organizational resilience. *European Journal of Operational Research, 242*(1): 261–273. doi: 10.1016/j.ejor.2014.09.055

Sanchis, R., L. Canetta, & R. Poler (2020). A Conceptual Reference Framework for Enterprise Resilience Enhancement. *Sustainability, 12*, 1464.

Small Business Administration (2019). *2019 small business profile*. SBA's Office of Advocacy. cdn.advocacy.sba.gov/wp-content/uploads/2019/04/23142719/2019-Small-Business-Profiles-US.pdf

SBA (2020). SBA and Treasury Announce Simpler PPP Forgiveness for Loans of $50,000 or Less. *Release Number* 20-81. sba.gov/article/2020/oct/08/sba-treasury-announce-simpler-ppp-forgiveness-loans-50000-or-less

Spillan, J., & M. Hough (2003). Crisis Planning in Small Businesses: Importance, Impetus and Indifference. *European Management Journal, 21*(3): 398–407.

Tuler, S., K Dow, & T. Webler (2017). "Chapter 5: How can we learn more from learning about risk controversies?" In R. E. Kasperson (Ed.), *Risk Conundrums* (1st ed., p. 298). Routledge. doi: 10.4324/9781315665894-6

Watson, M., Y. Xiao, J. Helgeson, & M. Dillard (2020). Importance of Households in Business Disaster Recovery. *Natural Hazards Review, 21*, 05020008.

Willows, R., & R. Connell (2003). *Climate adaptation risk, uncertainty and decision-making*. UK Climate Impacts Programme.