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Document Version
Final published version

Published in:
Journal of Purchasing & Supply Management

DOI:
10.1016/j.pursup.2021.100699

Publication date:
2021

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Citation for published version (APA):
Nikookar, E., Varsei, M., & Wieland, A. (2021). Gaining from Disorder: Making the Case for Antifragility in Purchasing and Supply Chain Management. *Journal of Purchasing & Supply Management*, *27*(3), Article 100699. https://doi.org/10.1016/j.pursup.2021.100699

Journal of Purchasing & Supply Management 27 (2021) 100699

Contents lists available at ScienceDirect

Journal of Purchasing and Supply Management

journal homepage: www.elsevier.com/locate/pursup

Gaining from disorder: Making the case for antifragility in purchasing and supply chain management

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ARTICLE INFO

Keywords:
Antifragility
Antifragile supply chain
Supply chain disruption
Resilient supply chain
Purchasing
Robust supply chain
Supply chain management
COVID-19

ABSTRACT

The purchasing and supply chain management (P&SCM) discipline assumes that supply chains are fragile systems, hence taking a "negative" approach toward disorder. Building on Taleb's concept of antifragility—the ability to *gain from disorder* rather than avoiding it—, we challenge this traditional assumption. The COVID-19 pandemic has revealed that some companies were indeed able to gain from disorder, whereas some of those that focused too much on robustness and resilience lost ground. Building robust and resilient supply chains may no longer be enough to thrive in today's highly volatile business world. This article sparks a new debate by introducing antifragility to the P&SCM literature and provides new directions for future research.

1. Introduction

Disorder, which refers to any volatility, randomness, stressors, errors, variability, uncertainty, and imperfect and incomplete knowledge, is now the rule of today's business world—not a choice (Taleb, 2012). In the purchasing and supply chain management (P&SCM) literature, we often assume that the desirable solutions to deal with disorder are to build either robustness or resilience into the supply chain. Robustness has been widely discussed in P&SCM as an approach that allows the supply chain to tolerate disorder and maintain its functionality (Brandon-Jones et al., 2014). Moreover, much of the research in the P&SCM literature conceptualizes resilience as the ability to bounce back from disorder (Sheffi and Rice 2005). Regardless of these solutions, the dominant approach to disorder in the P&SCM literature is negative because any type of disorder in the supply chain is seen as a source of disadvantage that must be avoided.

However, in today's world characterized by the ubiquity of disorder, such a negative approach remains questionable. What if we think positively about disorder and embrace it? What if we build a supply chain that can even gain from disorder, both financially and non-financially (e.g., social reputation)? Inspired by Taleb's (2012) work, this article aims to spark a debate by introducing antifragility to the P&SCM literature. Aiming for antifragile supply chains is a whole new (and positive) approach to disorder and randomness. Unlike robust or resilient supply chains, the antifragile supply chain "loves" disorder and thrives in the world of randomness. In other words, robust and resilient supply chains are placed on a continuum from the fragile to antifragile supply chain (Derbyshire and Wright 2014).

Our aim to introduce the antifragile supply chain is in line with the recent reflection on the past 25 years of the Journal of Purchasing and Supply Management, where the editors call for "refreshing and broadening the field in terms of perspectives, topics, and … building bridges between disciplines" (Zsidisin et al., 2019: 8). Antifragility is also relevant to practitioners, such as executives. For example, the managing director of a custom packaging company, who participated in an executive industry panel held in December 2020 in Australia, reported that the company not only survived but indeed gained from COVID-19 and achieved a growth of around 150% in 2020.

This article continues as follows: Section 2 reviews the characteristics of the current business world. Section 3 focuses on contemporary approaches to deal with disruptions that are discussed in the P&SCM literature. Section 4 elaborates on antifragility, and then the antifragile supply chain is defined in section 5. In section 6, the conventional wisdom in the practice and scholarship of P&SCM is challenged by revealing that they often unintentionally promote fragility. Here, some directions are provided to build antifragile supply chains. In section 7, the article concludes by proposing a set of avenues for future research.

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https://doi.org/10.1016/j.pursup.2021.100699
Received 14 January 2021; Received in revised form 11 May 2021; Accepted 17 May 2021
Available online 22 May 2021

2. Ubiquity of disorder

Over the last decades, globalization has caused supply chains to expand enormously. Many companies have formed a global supply chain to source their needs from suppliers scattered across the world while also entering international markets to sell their goods and services. Technological advancements and digitalization have played a substantial role in accelerating this trend because both buyers and suppliers, often geographically dispersed, can now easily trade. However, the expansion of supply chains has increased firms' exposure to disorder. Recent natural disasters, global health challenges, economic crises, regulatory changes, political instability, and climate breakdown have reminded us that supply chains are operating in an environment characterized by disorder (Taleb, 2012; Knight et al., 2019; van Hoek, 2020).

The COVID-19 pandemic is a striking example of disorder that has been wreaking havoc worldwide, taking several million lives and affecting the health of many more (WHO, 2020). Rapid, unpredictable, and in some cases irreversible changes triggered by this pandemic have interrupted countless supply chains across industries worldwide (Govindan et al. 2020). The outbreak has made many production plants and service delivery points, their suppliers, distribution centers, and transportation links temporarily or permanently unavailable (Deloitte, 2020; Ketchen and Craighead, 2020). Compounded with other characteristics of today's supply chains, including being overly optimized and globalized, COVID-19 has developed a runaway chain of material shortages or delivery delays that have extensively impacted the global market. The World Bank predicted that COVID-19 disruptions could result in a decline of between 5.4% and 9.7% in the global GDP in 2020, making it the deepest global recession in decades (World Bank, 2020).

Escalating pressure on profit margins has increased firms' tendency to employ efficiency strategies and overoptimize supply chains to reduce costs, for example, by outsourcing to low-cost markets (see Christopher and Towill, 2001). Although these strategies have helped firms achieve better margins, they have also led to more fragile supply chains because any disorder could potentially lead to a massive disruption (Peck, 2005). Supply chain complexity resulting from an overreliance on globalization and outsourcing makes such disruption quickly propagate and amplify both upstream and downstream (Craighead et al., 2007; Blackhurst et al., 2011)—a phenomenon known as the ripple effect (Ivanov et al., 2013). During the COVID-19 pandemic, supply chains that were supposed to be a source of sustained competitive advantage (Barney, 2012) have turned to be the Achilles heel of nearly 94% of Fortune 1000 companies (Fortune, 2020). The Institute for Supply Management (ISM) reported that the number was about 97% for other firms (ISM, 2020). While firms are often more concerned about fine-tuning their supply chain to maximize financial returns, many of them are unaware that the main danger is hidden in the ubiquity of random events and their supply chains' fragility when facing these events.

3. How do we typically deal with disorder?

As an initial attempt to systematically deal with disruption, supply chain risk management (SCRM) emerged in the 1990s (Fiksel et al., 2015). The primary purpose of SCRM is to minimize the negative consequences of supply chain disruption through a set of processes including risk identification, assessment, treatment, and monitoring (Norrman and Wieland, 2020). SCRM research at large rests on the assumption that the potential sources of disruption are, at least in principle, predictable (Wieland and Durach, 2021; Pettit et al., 2013).

A number of SCRM online platforms take unpredictable risks into account. However, they have partly overlooked some of the high-impact, low-probability risks. Conventional risk management approaches and even state-of-the-art SCRM platforms may be able to handle rare situations where disruptions are, to some extent, predictable, for example, supply chain disruptions due to volcano eruptions. However, they still struggle to address disruptions triggered by risk sources that are unprecedented and difficult to predict, such as supply chain disruptions caused by an earthquake. Apart from the subjective nature of risk identification, which has been criticized over the years (Pettit et al., 2013), Fiksel et al. (2015) assert that SCRM is based on historical data that may not be available, particularly at the time of decision-making.

Additionally, although commercial SCRM platforms appear to have addressed some of the concerns, much of the SCRM literature still implicitly evaluates potential risk sources independently, somewhat failing to recognize the interaction between the risk sources and environmental factors that may intensify disruptions. As a result, SCRM research possibly underestimates both the severity and probability of disruptions (Fiksel et al., 2015). It is evident that conventional risk management approaches and solutions are no longer sufficient to deal with the multifaceted nature of disruptions triggered by random events (Pettit et al., 2013). This has led to alternative approaches that proactively prepare supply chain managers for disruptions (Scholten et al., 2014; Norrman and Wieland, 2020). Therefore, as another approach to deal with disruptions, the concept of resilience has been introduced to the P&SCM literature by the works of Christopher and Peck (2004), Sheffi and Rice (2005), and other pioneering authors.

According to the dominant interpretation of resilience in the P&SCM literature, resilience supposedly enables a system (i.e., the supply chain) to "bounce back" after a disturbance. It is often defined as the ability and speed of the supply chain to return to its original state—and, if possible, to move into a more desirable state—after being disrupted (Brandon-Jones et al., 2014; Pettit et al., 2010; Sheffi, 2005; Christopher and Peck 2004). In this sense, resilience is defined as engineering resilience (Wieland, 2021; Wieland and Durach, 2021) and has been directly borrowed from mechanical engineering (see Sheffi, 2005). Like an engineer who aims for material to recover to its original shape after deformation, a supply chain manager aims for the supply chain to bounce back to its old structure and processes. However, this interpretation of resilience has also been contested. Recent research on supply chain resilience reinterprets resilience in the sense of social–ecological resilience (Wieland, 2021), that is, the ability to adapt and transform in the face of change (Wieland and Durach, 2021).

Although we acknowledge the value of SCRM and the dominant interpretation of resilience as engineering resilience, we argue that they both take a negative view to disorder in the sense that disorder is generally perceived as harmful, hence should be avoided. We argue that such a negative view to disorder may not be enough to thrive in today's world of randomness; it is therefore time to take the next step. The status quo in the P&SCM literature must be revamped, and the mindset must be shifted to consider disorder as a source of gain. Friedrich Nietzsche famously said, "What does not kill me makes me stronger." In this sense, a supply chain should be reinterpreted as a system that "loves" randomness and gains from disorder rather than losing ground. This is what antifragility is all about: an approach to embrace the world of randomness.

4. What is antifragility?

Nassim Nicholas Taleb has coined the term "antifragility" in his 2012 book, *Antifragile: Things That Gain from Disorder*. Therein, antifragile systems are introduced as follows:

> Some things benefit from shocks; they thrive and grow when exposed to volatility, randomness, disorder, and stressors and love adventure, risk, and uncertainty. Yet, in spite of the ubiquity of the phenomenon, there is no word for the exact opposite of fragile. Let us call it antifragile. Antifragility is beyond resilience or robustness. (3–4).

Taleb (2012) considers antifragility as the true antonym of fragility, rather than resilience and robustness to be the antonym, as they may appear to be at first glance. "The robust or resilient is neither harmed nor

helped by volatility and disorder, while the antifragile benefits from them" (Taleb, 2012: 17).

Antifragile systems embrace disorder and learn from it rather than avoiding it. Taleb (2012) argues systems get stronger by exposing them to disturbances, even intentional ones that are made to be similar to random events. Our immune system is a good example of an antifragile system. Worldwide, governments are hopeful they can flatten the curve of COVID-19 cases or even put an end to the pandemic by giving a vaccine to their people—intentionally exposing people's immune systems to a disturbance similar to what is induced by COVID-19. Clearly, the imposed disturbance needs to be well planned (Taleb, 2012). The vaccine needs to differ enough from a virus so it does not harm but makes our immune system stronger and prepares it in case it comes across the true challenge: real COVID-19.

As another example, Taleb (2012: 101) argues that small forest fires (i.e., stressors) cleanse the forest system: "Systematically preventing forest fires from taking place 'to be safe' makes the big one much worse." This is in line with a successful traditional fire management practice of the indigenous community in the Northern Territory of Australia; they intentionally light controlled fires at the right time in the right place to reduce wild bushfires later on. These fires have become more frequent and intense due to anthropogenic climate change.

In the same vein, "stability is not good for the economy" (Taleb, 2012: 101) as a whole and for the firms and supply chains embedded in the economy. These systems could become "very weak" during a long period of stability because hidden vulnerabilities accumulate to create trauma when a major disruption occurs. Random events might, however, not be as harmful for the long-term prosperity of complex systems, such as supply chains, if the current approach changes and we see disorder as an opportunity to learn and grow. According to Power (2013), there is a tendency for firms (including once leading and successful ones like Kodak and Digital Equipment Corp.) to avoid disturbances. Yet because disorder is inherent in our world, only antifragile supply chains can thrive—those that go beyond robustness or resilience to see disorder as an opportunity to become stronger.

Since Taleb proposed antifragility as the counterpole of fragility in 2012, the concept has inspired researchers and practitioners alike, finding numerous applications across disciplines as diverse as aerospace engineering (Jones, 2015), computer science (Jones, 2014; Verhulsta, 2014), risk analysis (Aven, 2015), finance and banking (Taleb and Douady, 2013; White, 2013), and mega-project management (Ansar et al., 2016). For example, it has been argued that banking and monetary systems can become antifragile by embracing a decentralized monetary policy, because centralization "has eliminated the market-based disciplinary and error-correction mechanisms that once governed money creation, thereby putting all our monetary eggs in one basket and creating monetary system fragility" (White, 2013: 472). In another example, examining evidence of 245 big dam projects with a total value of $353 billion, Ansar et al. (2016) find that mega projects are likely to be fragile. Small errors, even in one interaction within the mega project, are unlikely to be noticed, but they can magnify and lead to the failure of the entire project.

5. Defining the antifragile supply chain

Despite successful applications of antifragility in other disciplines, no attempts have been made to introduce antifragility to the P&SCM literature. We acknowledge that risk acceptance has been suggested as one possible strategy in SCRM (e.g., see Hajmohammad and Vachon, 2016). However, this strategy still assumes that risk events are something negative. Embracing disorder, which is the core of antifragility, has not been explicitly covered in our discipline yet. Interestingly, this is different in P&SCM practice because executives have already highlighted the relevance of antifragile supply chains. This is evident from a powerful statement made by Annette Clayton, CEO of Schneider Electric North America, at a practitioner summit on November 11, 2020, where she highlighted the importance of antifragility in strengthening Schneider's supply chain:

> We don't foresee a return to the old normal … we are preparing for a future of continual change. The key will be to thrive, not survive, in uncertainty. You will need … anti-fragility, which goes beyond resiliency—which means simply surviving the shock (Landon, 2020).

In a similar vein, a 2020 Financial Times article entitled "Companies Should Shift from 'Just in Time' to 'Just in Case'" encourages firms to aim for antifragility and go "beyond resilience and robustness" so that they can thrive in the new normal (Financial Times Editorial Board, 2020). In this context, robustness and resilience are mainly understood as ways to stabilize the existing conditions and avoid any disorder.

We believe it is time to take the next step and learn how the supply chain could become truly antifragile. Extending Taleb's (2012) definition of antifragility to P&SCM, we define an antifragile supply chain as *a living supply chain that can gain from disorder*. The antifragile supply chain is dynamic and fluid, not static, and it evolves and improves with unpredictable disorder as the inherent characteristic of today's business world. Instead of accepting negative consequences and thinking about how to "bounce back," antifragile supply chains allow us to turn challenges into opportunities and thrive in the world of randomness.

It is worthwhile to reiterate that "gain" referred to in our definition goes beyond financial benefits; it also includes non-financial aspects such as social and environmental benefits. The latter form of gain is materialized by embracing social or environmental disorder. For example, exploitation of workers is one type of disorder. In an antifragile supply chain, members embrace this type of disorder and closely collaborate to extinguish any form of human injustice, resulting in a social gain for the whole chain.

6. Some directions to build an antifragile supply chain

The purpose of this article is to begin a conversation that can inspire future research to find answers to several questions. How can P&SCM theory and practice turn from promoting fragility (e.g., overemphasizing efficiency, optimization, and globalization) to building antifragile supply chains? How can P&SCM scholars actively contribute to developing antifragile supply chains? Building on insights from Taleb (2012) and relevant research in other disciplines, we propose some directions to build antifragile supply chains. We focus on the reinterpretation of business practice and business scholarship because both managers (via the way they conduct business) and scholars (via the way they teach and conduct research) play important roles in building antifragile supply chains.

6.1. *Antifragile P&SCM practice*

Taleb (2012) relates a fragile system to "industry," a robust one to "small businesses," and an antifragile one to "artisans." Indeed, when talking or thinking about P&SCM, large industrial corporations might come quicker to our minds than small businesses, certainly even much quicker than artisans. Industrialization stands for standardization, optimization, and unification; in other words, it is all about removing randomness. Taleb (2012: 84) writes, "This is the central illusion in life: that randomness is risky, that it is a bad thing—and that eliminating randomness is done by eliminating randomness." He argues that artisans (e.g., taxi drivers, carpenters, tailors) have a certain degree of volatility in their income. However, they are pretty robust to disturbances that could bring this income to a temporary halt. Unlike the risks of industrial employees, which are hidden, the risks of artisans are visible. Taleb (2012: 84) writes, "Thanks to variability, these artisanal careers harbor a bit of antifragility: small variations make them adapt and change continuously by learning from the environment and being, sort of, continuously under pressure to be fit." Our discipline can learn from this

because we might have followed the wrong blueprint for too long. This has led to very efficient but also very vulnerable processes, structures, and products. We might now shift our attention to discover what we can learn about an artisanal interpretation of P&SCM.

Developing optionality (Russo and Ciancarini, 2017; Gorgeon, 2015), creating redundancy (Derbyshire and Wright, 2014), weakening the links between nodes (Hole, 2016), imposing eustress (Dahlberg, 2015; Derbyshire and Wright, 2014; Taleb, 2012), adopting a barbell strategy (Derbyshire and Wright, 2014; Taleb, 2012), allowing systems to fail fast (Hole, 2016), and conducting trial and error (Taleb, 2012; Derbyshire and Wright, 2014), effectuation (Derbyshire and Wright, 2014), and swarming (Jones, 2014) are among some of the ways that a system can move away from fragility and eventually resemble artisans, that is, to become antifragile. We have already established that developing optionality—or what we call flexibility in our discipline—and redundancy enables supply chains to deal with disorder (Jüttner and Maklan, 2011; Rice and Caniato, 2003; Bode et al., 2011). These could be starting points toward becoming antifragile. However, there are no formal attempts to contextualize the other aforementioned ways that may lead to creating antifragile supply chains. The transition from a fragile supply chain to one that gains from randomness requires supply chains to learn from other antifragile systems that share similar characteristics.

Many supply chains are tightly knitted; that is, suppliers are heavily dependent on one another, so much so that the failure of one or a small cluster of suppliers can trigger chain reactions and cause problems for other suppliers, eventually shutting down the whole supply chain. Examples include massive disruptions in the automotive supply chain because of the 2011 earthquake and tsunami in Japan, which affected other markets, thereby impacting supply chain partners globally (Lee and Rha, 2015). Drawing on insights from antifragile systems, the supply chain may become antifragile if it consists of modules that are connected to each other through "weak" links. Here, a link between modules is weak if one module's functionality in the set of modules is not severely impacted by misbehavior or failure of the other modules. This can be achieved by a well-defined interface that, although allowing for the exchange of information, does not create too much or any unnecessary level of dependence. Modularity and weak links within supply chains allow experimental approaches in the form of trial and error (Taleb, 2012; Derbyshire and Wright, 2014) by inducing eustress (Dahlberg, 2015; Derbyshire and Wright, 2014). In turn, this helps supply chain managers detect vulnerabilities early, learn quickly, and gain from disorder.

6.2. *Antifragile P&SCM scholarship*

According to Taleb (2012: 116), too much reliance on theories promotes fragility: "Theories are super fragile; they come and go, then come and go, then come and go again." Some theories underpinning the P&SCM literature have often been used in an oversimplistic way. For example, resource-based theory has been applied so that P&SCM can become a source of sustained competitive advantage (see Ramsay, 2001). These theories are being taught as if they were the truth, "without considering the impact of the possible errors from theory" (Taleb, 2012: 116).

Phenomenology, as "the observation of an empirical regularity without a visible theory for it" (Taleb, 2012: 116), is more robust. According to Taleb, phenomenology is more potent than theory, can lead to more rigorous policymaking, and, unlike theory, stays and is thus robust. In line with this, it has been argued that the accumulation of facts over time can sometimes be more important than already existing theory (see Pagell in Boer et al., 2015).

Finally, one step toward an antifragile alternative is the focus of science on experimental heuristics (or "practical tricks") instead of theory or phenomenology. In fact, theory often provides strict cause–effect relationships (e.g., certain characteristics of a resource will lead to a sustained competitive advantage), whereas an experimental heuristic, although it lacks this strictness (i.e., rigor), enables decision-makers to navigate a complex reality in a hands-on way because their "skins are in the game." An example is the adaptive cycle, which allows for understanding how systems stabilize and collapse (Wieland, 2021). Social phenomena are different from those in astronomy, and our discipline should hence refrain from mimicking the simplistic explanations of celestial mechanics.

Further, although there is a recent tendency toward more paradigmatic diversity (Darby et al., 2019), two approaches, empiricism and modeling, are still prevailing in P&SCM scholarship (see Dooley, 2009). Both are positivist in nature (Wieland, 2021). Ultimately, they ensure that the complexity of reality is captured in rules, variables, and formulas. This has led to theories that can explain the general case well but often fail to deal with deviations. This is particularly important when it comes to novel phenomena that are still waiting for an explanation. These approaches aim to generalize phenomena observed in the past, whereas business practices often consist of novel opportunities that will materialize only in the future. Consequently, the P&SCM discipline needs to rely much more on theoretical, methodological, and, above all, paradigmatic diversity than it does today. The fact that our discipline has strong roots in the social sciences does not align well with a positivist agenda. Instead, interpretative studies might be particularly useful because they do not rely on optimality but instead on understanding individual behavior, which is often decisive in business practice (Darby et al., 2019).

Taleb also uses three other metaphors; "soccer mom" represents fragility, "street life" robustness, and "barbell" antifragility. He has adopted the first metaphor from E. O. Wilson, a biologist who once answered the question of what hinders children's development the most: the soccer mom. Taleb (2012: 242) argues that "soccer moms try to eliminate the trial and error, the antifragility, from children's lives." In our role as P&SCM scholars, we should ask ourselves whether we take too much of the soccer mom's role, given that our research conveys supposedly optimal best practices, that is, solutions in a "one-size-fits-all" manner. The second metaphor, street life, reveals that humans tend to become more robust through real-life, which here might be novel problems experienced via case studies. Representing antifragility, the barbell metaphor refers to a dual attitude of playing it safe in some areas and taking many small risks in others. For P&SCM scholarship, this could mean shifting towards more interdisciplinary research (e.g., ecology, philosophy, anthropology), and thinking "outside the box."

7. Conclusions and future research opportunities

In this article, we introduced antifragility to the P&SCM literature. Taleb's book connects interdisciplinary wisdom from several centuries to shed light on how systems can benefit from disorder by building antifragility. Other disciplines, such as aerospace engineering, computer science (Jones, 2014; Verhulsta, 2014), risk analysis (Aven, 2015), finance and banking (Taleb and Douady, 2013; White, 2013), and project management (Ansar et al., 2016), have already adopted this notion, demonstrating its suitability for multiple areas. We believe that our article can inspire P&SCM scholars and practitioners, encouraging them to consider antifragility when developing a new research agenda and reimagining the supply chain.

Future research is encouraged to contextualize the ways suggested in the previous section in various industries, hence generating a new body of knowledge on building an antifragile supply chain. For example, a report by the National Association of Manufacturers (2020) highlights that 78% of manufacturing firms are severely impacted by the COVID-19 pandemic. There might be many lessons learned about the sources of fragility during the pandemic, which can help understand how to build an antifragile supply chain. Therefore, we believe that more exploratory, qualitative case studies in the manufacturing sector can be a good starting point for antifragile supply chain research.

Additionally, previous research proposes a set of organizational resilience barriers as factors being negatively related to supply chain resilience (Blackhurst et al., 2011). Such barriers might similarly exist for antifragility. Therefore, we encourage future researchers to explore the organizational barriers that obstruct or deter antifragile supply chains. Past research also demonstrates the decisive roles purchasing and supply chain managers play in dealing with disruptions (Nikookar et al., 2019). These roles might also exist in developing antifragile supply chains. Thus, future research may go beyond factors on the organizational level, offering additional insights related to the human factor's contribution in generating supply chain antifragility.

Finally, the nexuses between antifragility, digitalization, Industry 4.0 and sustainability in supply chains are fertile grounds for future conceptual and empirical research. For example, past research highlights trade-offs and tensions in sustainable supply chain design in light of economic, environmental, and social dimensions (Varsei and Polyakovskiy, 2017). However, the antifragility lens could rebalance such trade-offs, showing new ways of designing global supply chains in which social and environmental sustainability will enable antifragility. In other words, investment in social and environmental sustainability across the supply chain could make firms antifragile at the time of social and environmental disorder such as the climate crisis.

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