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Three Essays on the Effect of Scarcity on Consumer Behavior and Firm Performance

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Three Essays on the Effect of Scarcity on Consumer Behavior and Firm Performance

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Abstract

Studies have consistently shown that scarcity plays a significant role in shaping decision making. Under conditions of scarcity, individuals tend to behave impulsively, and firms are inclined to redefine their set of priorities and strategies, ultimately impacting their performance. Considering the scant investigation of the mechanisms and effects of scarcity in the supply chain management literature, this dissertation aimed to investigate the roles of scarcity in shaping consumer behavior and firm strategy in three essays.

The first essay investigated the effect of post-stockout scarcity disclosures on consumer responses to stockouts through the lens of product scarcity and signaling theory. The results of the experimental analysis indicate that post-stockout disclosures increase consumer perceived scarcity, reduce consumer satisfaction with the stockout situation, yet increase consumer purchase intention. However, the results of a time-effect analysis show that consumers' perceived scarcity and purchase intention decrease over time when stockouts persist. These results indicate that effectively communicating the reasons for the stockout, as well as actions being undertaken for replenishing the product can serve as a powerful tool to retain customers exposed to stockouts.

The second essay explored the role of retail product rationing (limit buys) in preventing stockpiling of essential products at retail stores during natural disasters through the lens of regret theory and anchoring effect. Results of an experimental investigation through manipulation of the number of items a consumer can buy and the presence/absence of disclosures highlighting social norms – or nudges, indicate that when consumers' needs were less than the retailer's set purchase limit, the purchase limit increased consumer stockpiling propensity. Additionally, though no significant effect of social nudges in the presence of a purchase quantity limit was

found, social nudges significantly reduced consumer stockpiling propensity when no limits were placed.

The third essay studied the effect of a firm's financial and operational slack on its green supply chain management (GSCM) performance by using the natural resource-based view and conceptualizing slack as a capability needed by a firm to reach its green supply chain goals. Results of a random effect model analysis indicate that the firm's absorbed slack and unborrowed slack (financial slacks), and capacity slack (operational slack) have a positive effect with diminishing returns on its GSCM performance. In contrast, inventory slack (a different kind of operational slack) has a negative effect with diminishing returns on a firm's GSCM performance. Moreover, we found that the firm's operating environment scarcity positively moderates the relationship between inventory slack and absorbed slack on GSCM performances GSCM performance. Environmental scarcity promotes a more efficient use of slack resources in the pursuit of green SCM efforts.

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Introduction

In the last few years, along with a long list of products, we have faced a shortage of medical supplies, vaccines, toilet paper, gasoline, affordable housing, and, most recently, baby food. Because of this, the notion of scarcity has taken a central stage in media, public discussions, firm performance analysis, and government policymaking. Surprisingly, studies focusing on scarcity in the supply chain management literature have been relatively scant. This dissertation explored this gap in the literature through three essays on scarcity in different contexts.

Scarcity refers to the age-old economic problem where demand for a good, service or resource exceeds supply. While consumer-centric literature often focuses on product scarcity, i.e., the scarcity of either goods or services, supply chain research at the firm level has concentrated chiefly on resource scarcity, looking at the scarcity of raw materials, water, food, oil, and precious metals. Scarcity can be supply or demand induced. With high-priced products, for example, limited supply drives scarcity. Conversely, for high-demand commodities, such as toilet paper or canned beans, the high demand drives scarcity. Researchers have noted that the mechanisms and effects of scarcity take place differently in the context of different individual needs, sources of scarcity, and product types. In this vein, the essays in this dissertation delves into the concept of scarcity in three different supply chain contexts: Essay 1 investigates supply-induced scarcity, Essay 2 explores demand-induced scarcity, and Essay 3 examines resource scarcity.

Essay 1 investigates the effectiveness of post-stockout disclosures, highlighting the scarcity of the product to counter negative consumer behavior. While supply chain literature traditionally considers stockouts as an adverse event for retailers, marketing research and anecdotal evidence indicate that some firms use stockouts to their advantage. Companies like Apple and Adidas often communicate the stockout of their products to increase the attractiveness of their product to new customers and to retain their existing customers, often using multiple channels such as their websites, social media accounts, and news media. Our study explored this phenomenon and investigated the effect of post-stockout disclosures on consumer responses to stockouts. The findings from two scenario-based vignette experiments indicated that post-stockout scarcity disclosures increased consumer perceived scarcity, which reduced consumer satisfaction but increased consumer purchase intentions. However, no additional effect was seen if these disclosures were sent through multiple channels. Additionally, the results of a time-effect analysis showed that consumers' perceived scarcity and purchase intention decreased over time when stockouts persisted.

Essay 2 investigates the effect of product rationing or purchase quantity limits set by a retailer during natural disasters on consumer stockpiling propensity. In addition, I studied how social nudges or signs highlighting socially acceptable behavior before natural disasters affected this effect. During natural disasters, retailers often aim to reduce consumer stockpiling behavior and promote equitable distribution by employing product rationing, i.e., placing purchase quantity limits on critical commodities. When the limits set by the retailer are higher than the consumer's needs, an anchoring effect may unintendingly lead consumers to buy more than their needs and towards the anchor. Thus, even though retailers may try to reduce stockpiling and fulfill the needs of a maximum number of consumers during disasters, having the purchase quantity limits higher than the needs may lead to unintended stockpiling. Results from a scenario-based experiment using responses through the Amazon Cloud research platform suggest that two mechanisms take place in the presence of an impending natural disaster. First, when consumers' needs were less than the retailer's set purchase limit, the purchase limit directly affected consumer stockpiling propensity due to anchoring effect. In addition, the set purchase limit of the retailer also had a negative indirect effect on consumer stockpiling propensity mediated by consumer perceived future regret. No significant impact of social nudges on consumer stockpiling propensity was found when there was a purchase quantity limit, but when there were no limits, they significantly reduced it.

Finally, Essay 3 looks at the effect of organizational slack or availability of free resources on the firm's green supply chain management (GSCM) performance. Traditional supply chain management literature has linked green supply chain management activities with waste reduction and increased efficiency. However, their adoption requires elements of change, innovation, and organizational flexibility, all of which require free resources above the firm's lean requirements or "slack." This essay aimed to determine the effects of both financial and operational slack on GSCM performance by following the tenets of the natural resource-based view and conceptualizing slack as an essential capability to accomplish green supply chain goals. The study also examined how a firm's operating environment's resource scarcity impacts these relationships. The two types of slack: financial and operational slack, were operationalized using publicly available data from Compustat and proprietary data from Sustainalytics databases. Based on a random-effect model analysis, the firm's financial slacks - absorbed slack and unborrowed slack – were found to have a positive effect with diminishing returns on its GSCM performance. In addition, firms' capacity slack (a type of operational slack) also had a positive effect with diminishing returns, while inventory slack (a different type of operational slack) had a negative effect with diminishing returns. Our findings also indicated that the firm's operating environment scarcity positively moderated the relationship between inventory slack and absorbed slack on GSCM performance.

As previously indicated, studies on scarcity have been scant; however, the implication of scarcity, especially in the post-covid world, has been widely felt and understood. My dissertation recognizes this opportunity and brings the concept of scarcity to research streams at an individual level: such as consumer response to stockout, consumer response to natural disasters, and at an organizational level looking at outcomes of organizational slack. The dissertation also examines how scarcity can impact predictions of existing theories such as signaling theory, anchoring effect, and natural resource-based theory under various contexts. The dissertation opens up the practically and theoretically relevant discussion on the effect of scarcity on extant theories and well-studied contexts such as retail strategy and consumer behavior and firm performance. The dissertation also offers considerable managerial implications for the retail managers in dealing with stockouts or better planning retailer response during a natural disaster. Additionally, it offers guidance for operations managers on how to optimize their various slacks to maximize their environmental performance.

Essay 1: When Life Gives You Lemons, Make Lemonade: The Role of Post-stockout Disclosures on Consumer Response to Stockouts

Abstract

Traditional supply chain management literature has linked stockouts with negative consumer responses such as increased dissatisfaction, smaller, delayed, and canceled purchases, as well as brand and retailer switching. While recent consumer-centric supply chain management and marketing literature has highlighted that disclosures of low inventory levels can serve as a potential strategy to influence consumer outcomes, the mechanisms and effects of disclosures after stockouts take place are yet to be investigated. In this vein, following the premises of signaling theory and the scarcity principle, this study investigates the effect of post-stockout scarcity disclosures as a mitigation strategy for tempering such negative consumer behaviors. Results of two scenario-based vignette experiments indicate that post-stockout scarcity disclosures increase consumer perceived scarcity, which in turn reduces consumer's satisfaction but yet increases consumer purchase intentions. In addition, it is found that these results do not change if signals are sent through multiple channels. Lastly, results of a time-effect analysis show that consumers' perceived scarcity and purchase intention decrease over time when stockouts persist. Altogether, these results underscore the potential effectiveness of specific scarcity disclosures strategies for customer retention even in the face of stockouts.

Keywords: *Stockouts; Disclosures; Scarcity; Experimental design; Signaling theory*

Introduction

On August 12, 2019, Popeyes, a famous Southern-style fried chicken fast food restaurant, launched the new “Popeye chicken sandwich” (Wong, 2019). However, due to disruptions stemming from its chicken fillet supply, the sandwich was stocked out from stores within the first two weeks of its launch (George-Parkin, 2019). Nevertheless, rather than considering the stockout as a hindrance, Popeye promoted it to be a testament to its chicken sandwich’s quality and taste. The demand for the unavailable sandwich skyrocketed, and consumers waited in long lines, even days after the sandwich was back in stock (Rosenberg, 2019). This strategy is followed by other companies, such as Adidas and Supreme, whose anticipated or actual stockouts have been used to create a buzz to stimulate demand (Wang, 2016; Ferla, 2017).

In contrast to the example above, the supply chain literature has often linked stockouts with adverse effects on a firm’s bottom line and consumer behavior (Zinn & Liu, 2001; Kim & Lennon, 2011; Scarpi & Pizzi, 2013). One of the most noticeable consequences of a stockout for retailers is lost sales (Zinn & Liu, 2001). According to Buzek (2018), loss of sales resulting from stockouts worldwide amounts to $984 billion per year. Stockouts have also been linked with intangible adverse effects on consumer behavior. Extant literature has established that stockouts lead to consumer dissatisfaction (Kim & Lennon, 2011; Scarpi & Pizzi, 2013). Such dissatisfaction results in negative behavioral responses (Zinn & Liu, 2001; Sloot et al., 2005), such as substituting the product with a competing brand, delaying the purchase of the product, or leaving the retail store and shopping elsewhere (Zinn & Liu, 2001).

While supply chain literature traditionally considers stockouts as an adverse event for retailers, marketing research (Balachander & Farquhar, 1994) and anecdotal evidence indicate that some firms use stockouts to their advantage. Companies like Apple and Adidas often communicate the stockout of their products to increase the attractiveness of their product to new customers and to retain their existing customers (Lewittes, 2021), often using multiple channels such as their websites (Peinkofer et al., 2016), social media accounts (Bazarova & Choi, 2014), and news media (Guillamon-Saorin et al., 2012). Our study explores this phenomenon and investigates the effect of post-stockout disclosures (i.e., the release of targeted information) on consumer responses to stockouts. Specifically, we address the following research questions:

1. What is the effect of post-stockout disclosures on consumer responses to a stockout?
2. How does the response change when there are multiple sources of post-stockout disclosures?
3. How does consumer response to such disclosures change over time when the stockout persists?

We argue that the mechanism that can explain how a post-stockout disclosure strategy increases the attractiveness of a stocked-out product relates to scarcity. Scarcity refers to a fundamental economic problem where the demand for a product exceeds its supply (Shi et al., 2020). Perceived scarcity suppresses consumers' cognitive and rational thinking and increases the demand for a product, as consumers assume that what is less available is more valuable (Suri et al., 2007; Cialdini, 1987). Following signaling theory (Spence, 2002), we posit that such disclosures act as signals that link their stockouts with scarcity, thus increasing a product's desirability and, consequentially, consumer outcomes.

We utilize two scenario-based experiments to test our hypotheses. The first between-subject experiment looks at the effect of post-stockout scarcity disclosures on consumers' perceived scarcity, satisfaction with the stockout situation, and purchase intention. It further scrutinizes the effect of multiple sources of disclosures on consumer response. The second experiment is a within-subject design that examines the effect of time on consumer response to stockouts. Results indicate that post-stockout scarcity disclosures increase consumer perceived scarcity, which reduces consumer satisfaction but increases consumer purchase intentions, even if these signals are sent through multiple channels. These relationships, however, decrease over time if stockouts persist.

The study's most significant contribution is to the consumers' response to stockout literature by investigating the mitigation strategy to control the negative consumer outcomes linked with stockouts. Specifically, our study adds post-stockout scarcity disclosure to the list of other strategies, such as offering price promotions and shipping directly to consumers, as a post-stockout strategy to counter negative consumer behavior (Rao et al., 2011; Peinkofer et al., 2015). Second, our study highlights the relationship between the firm's post-stockout disclosures, consumer satisfaction with the stockout situation, and purchase intention after facing stockouts. Our study suggests a negative relationship between post-stockout scarcity disclosures and satisfaction with stockout situation and expands on prior supply chain management research that had found a similar relationship for inventory disclosures before stockouts (Peinkofer et al., 2016). Contrary to our hypothesis, we found that in a stockout scenario, perceived scarcity can negatively affect consumers' satisfaction with the stockout situation and positively affect their purchase intention. Third, our study highlights the effect of the passage of time on post-stockout signals on perceived scarcity and purchase intention. These findings add to the prior management research that investigated the role of repeated signals from firms positively influencing investor valuation of a firm (Janney & Folta, 2003; 2006). The study also adds to the stream of literature that uses signaling theory to study the effect of signal congruence on various firm-level outcomes (Janney & Folta, 2003; 2006; Stern et al., 2014; Mindrut et al., 2015; Lin & Tseng, 2016; Drover et al., 2018). Lastly, our research offers guidelines to supply chain managers on using disclosures to take advantage of planned and unexpected stockouts to improve consumers' experience. Specifically, this study delineates strategies for post-stock-out disclosures and communication channels. Using the resulting perceived scarcity triggered by stockouts, managers can utilize stockouts to generate positive consumer outcomes even though, traditionally, stockouts have been linked with adverse consumer behavioral responses.

Background

Consumer Response to Stockouts

Over the last few years, there has been a growing interest in consumer-centric supply chains amid a call for integration between consumers' perceptions, values, choices, and behaviors and performance outcomes of logistics and supply chain management (Ta et al., 2015; Esper et al., 2021). One of the prevailing themes in this research stream relates to consumer response to various inventory management practices and their failures (Rao et al., 2011; Scarpi & Pizzi, 2013; Peinkofer et al., 2015; Peinkofer et al., 2016; Xu et al., 2017; Nguyen et al., 2019). Stockouts are one such failure that has received significant attention from researchers and practitioners because it can lead to consumer dissatisfaction (Peinkofer et al., 2016) and negatively affect their perception of the store and the product (Zinn & Liu, 2001; 2008). An adverse perception can further impact consumers' future purchase decisions (Kim & Lennon, 2011). Thus, stockouts can negatively impact consumers' decisions, leading consumers to delay or postpone their purchase, purchase a competitor's product, or switch stores (Sloot et al., 2005; Zinn & Liu, 2008; Koos & Shaikh, 2019).

These negative outcomes have led researchers to study the attributes that affect consumer response to stockouts. Researchers have found that consumer and product attributes, such as consumers' brand loyalty, product type, product uniqueness, and brand equity, can weaken the impact of stockouts on negative consumer behavior (Zinn & Liu, 2008; Kim & Lennon, 2011; Scarpi & Pizzi, 2013; Ku et al., 2014). Similarly, consumers' thinking type also affects their perception of stockouts: analytical thinkers evaluate out-of-stock events more negatively than holistic thinkers (Ma et al., 2019). Strategies like inventory transparency (i.e., how inventory levels are communicated to consumers just before stockout) have been proposed as a guard against consumer dissatisfaction when the actual stockout transpires (Kim & Lennon, 2011; Ku et al., 2014; Peinkofer et al., 2016; Park et al., 2020).

One of the mechanisms suggested by researchers who have used pre-stockout disclosures as a guard against negative consumer behavior is consumer competition. They have argued that disclosures about limited inventory just before stockouts yield a scarcity effect among consumers and create a sense of competition which might help mitigate negative consumer behavior (Peinkofer et al., 2016). The scarcity might become more observable in a post-stockout scenario as the product is not available for immediate purchase.

Product Scarcity Effect

Scarcity refers to the economic problem where demand for a good, service or resource exceeds supply (Shi, Li, and Chumnumpan 2020). Consumers often encounter product scarcity (i.e., scarcity of either goods or services) (Shi et al., 2020). The product's perceived rarity or limited availability can increase consumers' perceived scarcity of the product (Cialdini, 1993). Product scarcity can be unintentional or deliberate. Unintended scarcity may result from firms failing to match market demand due to unexpected supply problems or unexpected demand increases (Shi et al., 2020). At the same time, deliberate strategies may include firms intentionally lowering/limiting product supply or disregarding surging market demand (Shi et al., 2020). Academic literature differentiates between two types of product scarcity: supply-induced scarcity and demand-induced scarcity (Shi et al., 2020). Supply-induced scarcity results from a limited supply of a product, whereas demand-induced scarcity is driven by high demand for a product. Product attributes such as its dispensability for the consumer and availability with respect to anticipated consumer demand can make them susceptible to supply-induced scarcity and/or demand-induced scarcity. For instance, for regular use of indispensable products, such as toilet paper or canned food, perceived scarcity increases desirability due to consumers' need for conformity, especially during natural calamities (Bernheim 1994; Eisend, 2008; Jones, 1984; van Herpen et al., 2009). People buy and hoard such products because they see others buying them, and thus they want to conform with others, making such products more susceptible to demand-induced scarcity.

Conversely, perceived scarcity increases desirability in high-quality limited supply products due to consumers' need for uniqueness (Brock, 1968; Lynn, 1991; Roy & Sharma, 2015; Wu et al., 2012). Consumer-centric literature explains the underlying psychological effects of supply-induced scarcity through the lens of commodity theory (Brock, 1968; Lynn, 1991). Commodity theory suggests that consumers value a commodity to the extent it is unavailable (Brock 1968). Brock (1968) suggests the possible mechanism of perceived scarcity: Consumer links the perceived scarcity for the product with its uniqueness and exclusivity. Consumers desire scarce goods as a way to differentiate themselves from others and thus seek products that signal their uniqueness (Fromkin & Snyder, 1980; Belk, 1988; Shi et al., 2020). Uniqueness enhances product attractiveness (Szybillo, 1975) and desirability (Lynn, 1991) among consumers (Vigneron & Johnson, 1999). Consistent with this explanation, studies have found that people high in the need for uniqueness show a stronger preference for scarce products (Fromkin, 1970;

Powell, 1974; Lynn & Harris, 1997). Product scarcity has been the focus of few studies in supply chain management. Product scarcity due to supplier strategies has been linked with lower returns in retail (Ishfaq et al., 2016). Similarly, product scarcity stemming from supply shortages has been linked with hoarding and phantom ordering by ordering more than they need to meet demand by downstream customers (Sterman & Dogan, 2015). Studies that use consumer insights to develop supply chain strategy have used low inventory disclosures before stockouts as a tool to increase consumers' perceived scarcity and mitigate the negative consumer behavior when the stockouts manifest (Peinkofer et al., 2016; Park et al., 2020). However, findings from theses studies indicate that these scarcity related disclosures actually reduced consumer satisfaction with the stockout situation (Peinkofer et al., 2016; Park et al., 2020) and increased product returns (Rao et al., 2014). Recent studies have found that although pre-stockout scarcity messages increase sales for stock-keeping units (SKUs) with extreme retail profit margins (extremely high or extremely low), such messages can negatively impact sales for all other SKUs with moderate margins (Park et al., 2020). However, while the existing literature has focused on pre-stockout disclosures, post-stockout strategies using disclosures remain unexplored. For firms, stockouts sometimes become unavoidable even with the utmost care; thus, studying possible post-stockout actions becomes highly relevant. As stockouts can be considered an extreme version of scarcity, this linkage between a post-stockout scenario with scarcity can offer a post-stockout strategy to increase consumer satisfaction and prepare the consumer to wait for the product to be back in stock. Marketing research has acknowledged that scarcity can be a useful tool for enhancing consumer outcomes (Shi et al., 2019). Therefore, this study posits that after stockouts, disclosures highlighting the product's unavailability can highlight the product's scarcity, make the product more desirable, and possibly decrease consumer dissatisfaction linked with the stockout.

Theoretical Foundation: Signaling Theory

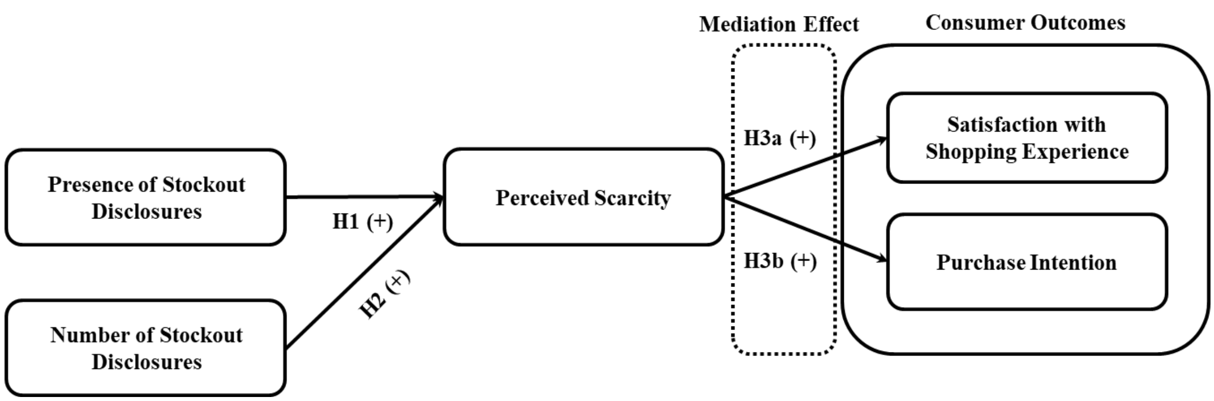
Signaling theory, postulated by Spence (1973) concerning labor economics, explained the process of decision-making while managing information asymmetry in economic models (Spence, 1973; Spence, 2002). It has since been expanded to reduce information asymmetry among various transacting actors in a market (Connelly et al., 2011). Signaling theory categorizes these actors as signal senders and receivers (Connelly et al., 2011; Spence, 2002; Taj, 2016). Strategic decisions by these actors are often characterized by information asymmetries between the signal sender and signal receiver (Bergh et al., 2014). When the signal receiver is the decision-maker, and the sender is a high-quality actor, the sender sends an observable signal highlighting their quality to the receiver to reduce the information asymmetry (Ross, 1973). Here, quality refers to the underlying, unobservable signaler's ability to satisfy the needs or demands of the receiver (Connelly et al., 2011). The theory suggests that the signal is often a deliberate communication of positive attributes about the quality of the sender in an effort to influence the decisions of the receiver (Connelly et al., 2011; Moratis, 2018). The signaler stand to benefit from the receiver's action based on the signal (Spence, 1973, 2002; Connelly et al., 2011). However, the receivers act on the signals only when the signals are observable or visible to the receiver (Warner et al., 2006; Ramaswami et al., 2010), and they believe that they stand to gain through the decisions the signal helps them make (Spence, 1973, 2002). Moreover, this influence of the signal on the receiver is can be enhanced by the signal's attributes such as its reliability or credibility in the eyes of the receiver (Busenitz et al., 2005; Sanders & Boivie, 2004) and its frequency or the number of times the same signal is transmitted to the receiver

(Baum & Korn 1999; Carter ,2006). Signaling theory is extensively used in the marketing and management literature which considers the firms as signalers and it's stakeholders or consumers as the receivers. Firms convey positive organizational attributes through signals and stakeholders (Connelly et al., 2011; Paruchuri et al., 2021) or consumers (Anisimova, 2007; Coker, Flight, & Baima, 2017) react to these signals as they believe they stand to gain because of this knowledge from the signals.

Signaling theory has gained recent attention from operations and supply chain scholars (Hofer et al., 2012; Rao et al., 2018; Duan et al., 2020; Wallenburg et al., 2021). Consumer-centric studies have applied signaling theory in different contexts in which firms enact signals to reduce information asymmetry with their potential and existing consumers. For example, studies have found that competitors' environmental management actions can act as signals that can influence the focal firm to take a similar action (Hofer et al., 2012). Researchers have found that consumers' evaluations of firms are impacted by different signals, such as supplier monitoring activities (Duan et al., 2020), product packaging strategies (Wallenburg et al., 2021), and return time leniency (Rao et al., 2018). Stockouts present one such situation where an information asymmetry might exist between the firm and its consumers. Thus, post-stockout disclosures from the firm can act as a signal to influence consumer response by informing the consumer about the low supply and high quality of the product.

Drawing on these theoretical foundations of signaling theory, we developed a conceptual model (Figure 1). In our context, the retailer is the sender and the consumer the receiver. In a post-stockout situation, information asymmetry exists because the retailer would know why a product was out of stock, whereas the consumer would not have this knowledge. However, by informing the consumer about the low supply and high quality of the product via a post-stockout disclosure, the retailer can close this information gap. In this situation, the post-stockout disclosure acts as a signal from the retailer to the consumer, influencing the consumer's perceived scarcity for the product and subsequently affecting consumer sentiments and behaviors. Figure 1 suggests that the consumer's perceived scarcity may mediate the relationship between post-stockout disclosure and further consumer outcomes such as consumer satisfaction and purchase intention. As the frequency of post-stockout disclosure sources increases, consumers' perception of scarcity may also mount.

Figure 1: Proposed Model



The Relationship Between Frequency of Post-Stockout Disclosures, Perceived Scarcity, and Consumer Outcomes

Post-Stockout Disclosures as Signals

Stockouts are often unanticipated and may occur from different reasons. Consumer unawareness about the reasons for the stockout causes confusion and frustration, frequently yielding negative consumer attitudes and behaviors towards the firm (Fitzsimons & Simester, 2006). Sellers often have more information on the reason behind the stockout, and the approximate estimate of when the product should be available again. To reduce consumers' ambiguity and prevent negative consumer response, sellers may attempt to reduce the information asymmetry releasing out-of-stock messages that act as signals that inform consumers about the reason behind the stockout (Rao et al., 1999; Rao et al., 2018; Wells et al., 2011; Rezaee, 2018; Anggraini & Tanjung, 2020).

When disclosures highlight that the stockout was due to the low supply of a high-quality product, these signals inform the consumer that the product is scarce. Specifically, signaling theory posits that such disclosures increase the observability or visibility of the reason for the stockout, increasing the effectiveness of the message on the receiver (Connelly et al., 2011). In other words, the post-stockout disclosure effectively reinforces the awareness of the limited supply of the product and, as such, the scarcity of the product in the consumers' minds. This discussion leads to our first hypothesis.

H1: The presence of post-stockout disclosures is positively associated with a consumer's perceived scarcity of the product.

Multiple Channels and Perceived Scarcity

The firm can share stockout disclosures through various channels such as the press (Guillamon-Saorin et al., 2012), social media (Bazarova & Choi, 2014), and company websites (Peinkofer et al., 2016). Signaling theory posits that increasing signal frequency while maintaining signal congruence (Balboa & Marti, 2007; Gao et al., 2008) can improve signal effectiveness (Janney & Folta, 2003). Specifically, multiple signals reiterate the signaler's quality, and the receiver finds the signal to be endorsed from multiple sources and thus more believable (Stern et al., 2014; Plummer et al., 2016; Drover et al., 2018; Vergne et al., 2018; Vanacker et al., 2020). Furthermore, when multiple signals convey the same message, they are considered congruent (Connelly et al., 2011). Congruent signals increase the efficiency of the signaling process as the messaging in them remains consistent, making it more believable and thus more effective (Balboa & Marti, 2007; Gao et al., 2008). Hence, when consumers receive the same or congruent scarcity signal highlighting a product's limited supply from multiple channels, the effectiveness of the scarcity messaging increases (Plummer et al., 2016; Paruchuri et al., 2019; Paruchuri et al., 2021) and subsequently their perceived scarcity also increases.This discussion leads to our second hypothesis.

H2: As the number of channels of post-stockout disclosures increases, consumer perceived scarcity increases.

Effect of Perceived Scarcity on Consumer Outcomes

A product's value to a consumer is dependent on its availability: consumers value products more that seem to be unavailable rather than those that are readily available (Brock, 1968; Lynn, 1991). Consumers desire such scarce goods to differentiate themselves from others and signal their uniqueness (Fromkin & Snyder, 1980; Belk, 1988; Shi et al., 2020). Thus, scarce products exhibit higher attractiveness and desirability among consumers (Szybillo, 1975; Lynn, 1991; Vigneron & Johnson, 1999).

While facing stockouts, when consumers encounter scarcity signals through disclosures highlighting the low supply of the product, their perceived scarcity increases. When a stockout of a product is perceived to be scarce by consumers, they attribute the stockout to its high desirability and attractiveness (Szybillo, 1975; Lynn, 1991; Vigneron & Johnson, 1999). Consumers link it with high quality and uniqueness (Lynn, 1991; Brock, 1968) rather than tying it with the firm's supply chain failure. The understanding of the high desirability of the product makes the consumers become lenient towards the stockout. Consumers' dissatisfaction with the stockout situation decreases, and the purchase intention for the product increases. Moreover, increased product desirability in their own mind makes the consumers accommodating and even eagerly willing to wait for the product to be available again. With this reasoning, we hypothesize the following:

H3: Consumer-perceived scarcity mediates the positive relationship between post-stockout disclosures and consumer a) satisfaction and b) purchase intention in the post-stockout situation.

Methodology

Experimental Development

To test our hypotheses, we used a scenario-based experimental design. Following Rungtusanatham et al., (2011), we employed a three-step process for our vignette design (i.e., pre-design, design, and post-design stage). The pre-design stage is used for information gathering, where the context of our research question is investigated to ground our design in a factual scenario, i.e., study post-stockout disclosures used by actual firms. In this stage, the experimental scenario, the variables of interest, and the various level of manipulation of the independent variable (Alexander & Becker, 1978) were determined. On completion of the pre-design stage, we moved to the design stage. In this stage, the appropriate measures for our variables of interest were selected. The experimental scenario was implemented through a common module (i.e., the section of the experiment that remains the same across the various treatments) and experimental cues modules (i.e., the section varies as per the treatment). And finally, in the post-design stage, we reviewed our vignette for clarity, and missing information added realism and manipulation checks. To ensure our research context is grounded in reality, we reviewed the nature and sources of post-stockout disclosures from various manufacturing firms and existing supply chain management (SCM) literature. We identify that the post-stockout scarcity disclosures intending to increase consumers' perceived scarcity specifically highlight the limited supply and the superior quality of the product (Balachander et al., 2009; Stock & Balachander, 2005), and firms primarily used their company's eCommerce website to disclose this post-stockout information. Firms such as Adidas and Popeye, along with using their websites, also used additional channels, such as news and social media, to show their product to be scarce. In fact, prior SCM literature had used company websites (Peinkofer, 2016; Park et al., 2020), newspapers (Nichols et al., 2019), and Twitter (Schmidt et al., 2020) for firm-level disclosures in different contexts.

Taking note of the literature and the actual implementations, we determined that the post-stockout scarcity disclosures had three levels. Post-stockout scarcity disclosures could either be absent or present and were communicated to the consumers through single or multiple channels. Taking this into account, we started creating the hypothetical shopping scenario. Following Rungtusanatham et al., (2011), we developed the common module (part of the hypothetical scenario that is held constant across all the treatment groups). This module involved creating a shopping scenario where consumers are presented with a hypothetical mid-priced mobile phone priced at $500 for sale. However, consumers could not buy the phone as it was stocked out. A mid-priced generic mobile phone was used to avoid consumer desirability due to brand value.

This product was consistent with Peinkofer et al. (2016), which used an electronic tablet to study the effect of pre-stockout disclosures on consumer outcomes.

We then proceeded toward the experimental module (part of the hypothetical scenario that varied across treatment groups). The respondents in Treatment 1, or the control group, were exposed to a generic post-stockout disclosure through the firm's website, highlighting that firm was working with its suppliers to bring the product back in stock. Treatment 2 group was exposed through the firm's website to the same message from Treatment 1, along with an additional statement highlighting the product's high quality and limited availability. Treatment 3 group was exposed to the same message as Treatment 3 through three different channels, i.e., the firm's website, social media account, and an online news article. The finalized scenarios were also presented to a panel of experts for feedback concerning clarity and realism. Based on their feedback, adjustments were made. The study was carried out using the Qualtrics survey tool and by running the survey through the Amazon Cloud Research platform (Litman et al., 2017). Only US workers were selected to avoid introducing confounds. An MTurk filter was used to choose workers who had at least completed 1000 tasks before taking our survey and having and having at least a 90% approval rate to increase the quality of the responses.

Pre-Test

We conducted a pre-test to assess the validity of our manipulations and analyze perceived quality to ensure that we are manipulating product scarcity and not product quality through our manipulation. The Amazon Cloud Research platform was used to collect responses from 28 randomly assigned respondents to Treatments 1, 2, and 3 (Litman et al., 2017). The mean age of the respondents was 39 years, and 39% of respondents were female. The respondents' median gross income was between $30,001- $50,000, and the median education level was a 4-year college degree. The product’s perceived quality was evaluated using a 4-item, 11-point Likert scale (Aaker, 1996, 1997; Yoo et al., 2000). On a realism scale, the scenarios scored on an average of 7.5 realistic on an 11-point scale (Eckerd et al., 2013). One-way ANOVA analysis found no significant difference in perceived quality between the groups (df= 2.00, F= 0.44, p= 0.65) (Please refer to Table 6 in the appendix).

Experiment 1

Manipulations, Manipulation Checks, and Sample

Experiment 1 constitutes a 3 (no-disclosure vs. post-stockout scarcity disclosures through website vs. post-stockout scarcity disclosures through the website, social media, and news) x 1 between-subjects design. Using the Amazon cloud research platform, 186 initial responses were collected for Experiment 1, with each worker receiving compensation of $1 for participating in the study. In line with Goodman et al., (2013), we included an attention check. Two participants failed the attention check and were removed to increase data quality (Abbey & Meloy, 2017). Additionally, an instructional manipulation check was embedded to check whether the participants read the instructions correctly (Oppenheimer et al., 2009). Three participants failed this check and were removed from the sample.

Demand effect results "from changes in behavior by experimental subjects due to cues about what constitutes appropriate behavior” (Zizzo, 2010, p. 75). Demand effect can affect experimental results if participants change their behavior based on their beliefs about the researcher's desired outcomes, and this behavior change is correlated to the research's objectives (Zizzo, 2010). Demand effect can result from an explicit or implicit indication, such as the instructions of the experiment or the behavior of the experimenter and can systematically bias an experiment participant's response to a treatment (Lonati et al., 2018; Eckerd et al.,2021). To avoid demand effect as suggested by Lonati et al., (2018) respondents in each treatment were introduced to the same baseline level or common module. For our treatment conditions, we added a single extra line highlighting the product's limited supply and high quality, which are the core attributes of limited supply scarcity. Additionally as suggested by Eckerd et al. (2021) the between subject design further reduces the likelyhood of presence of demand effect. Two factual manipulation checks were used to test the validity of experimental manipulations (absence, presence of one, or presence of multiple post-stockout scarcity disclosures) on the participants (Bachrach & Bendoly, 2011; Perdue & Summers, 1986). A factual manipulation check collects objective responses to factual questions about information included under each treatment (Kane & Barabas, 2019). The first factual manipulation check validated whether the respondents remembered the exact message displayed on the firm’s website. The two available options were a message without post-stockout scarcity disclosure (i.e., as introduced in Treatment 1) and a message with post-stockout scarcity disclosure (as in Treatment 2 and 3). The respondent had to choose the right picture per their treatment condition to pass this check. The second manipulation check validated whether the participants remembered the various channels which were shown to them during the treatment (please refer to appendix). 13 participants failed the manipulation checks and, thus, were removed from the data to ensure data quality (Abbey & Meloy, 2017). Moreover, we checked for flatlining or straight-lining, i.e., respondents giving identical responses to items presented in multiple grids (Smith et al., 2016). One record was rejected from the sample for straight-lining. Participants perceived the scenarios as highly realistic with a median response of 9 on an 11-point Likert scale checking for the scenario's realism (Eckerd et al., 2013).

The final sample consisted of 163 responses. 46 percent reported themselves as Female. The age of the participants varied between 20 and 70 years, with a mean age of 37.35. The median income was in the range of $30,001-$50,000, and the median education level was 4-year college education.

Measures

Our three dependent variables of interest, perceived scarcity, satisfaction with the out-of-stock situation, and purchase intention were adopted from the existing supply chain, marketing, and organizational psychology literature.Perceived scarcity was adapted from Wu et al., (2012) and was measured with afour-item, 11-point Likert-scale (1 = strongly disagree; 11 = strongly agree). The two consumer outcome variables, i.e., satisfaction with the out-of-stock situation and purchase intention, were adapted from Wallace et al. (2004) and Spears & Singh (2004), respectively. The satisfaction with the in-stock/out-of-stock situation scale was measured with a two item, 11-point Likert scale(1 = extremely dissatisfied; 11 = extremely satisfied). Purchase intention was measured with a five- item, 11-point Likert scale (Item1: 1= Never; 11= Definitely, Item2: 1= Definitely do not intend to buy; 11= Definitely intend to buy, Item3: 1= Not interested in buying; 11= Very interested in buying, Item4: 1= Definitely do not buy it; 11= Definitely buy it, and Item5: 1= Probably not buy it; 11= Probably buy it).

Confirmatory Factor Analysis

Convergent and discriminant validity assessments of the dependent variables were carried out through confirmatory factor analysis (CFA) using MPLUS 8. A three-factor model was estimated, including perceived scarcity, purchase intention, and satisfaction with the stockout situation. The first item of perceived scarcity, SCB1, was removed due to a low loading value of 0.37 (Wieland et al., 2017).

The fit statistics supported our measurement model (Kline, 2005) with $\chi 2$ = 94.97, df = 43, comparative fit index (CFI) = .96, root mean square error of approximation (RMSEA) = .09 (90% confidence interval: 0.06; 0.11), and standardized root mean square residual (SRMR) = .12. The average variance extracted (AVE) was calculated to establish convergent validity, and Cronbach's α was calculated for reliability analysis. The AVE for each factor exceeded the recommended threshold of .5 (Fornell & Larcker, 1981), and all three α values exceeded .8 (Nunally & Bernstein, 1994). Furthermore, the AVE of each factor was higher than the phi square correlation of each factor pair, suggesting discriminant validity (Fornell & Larcker, 1981). Table 1 provides a summary of the standardized loadings and AVE and α values. Table 2 provides the correlation matrix for the variables of interest. Upon confirmation of the measurement model, following best practices, the mean-centred factor scores were extracted using the CFA model and the Bayes estimator (Calantone et al., 2017).

Table 1: Experiment 1 Dependent Variable Analysis

Variables	Adapted From	Definition	Items		Loading	AVE and α*
Perceived Scarcity (Mediator)	Wu et al. (2011)	The perception of the distinctiveness of the product based on its limited supply (Tian et al. 2001)	SCB2	Considering the shopping scenario, you just experienced, please rate the following statements. - I think that the Q phone 19 sold out soon.	0.71	
			SCB3	Considering the shopping scenario, you just experienced, please rate the following statements. - I think that many people will buy the Q phone 19, when available.	0.87	AVE= 0.65 α= 0.88
			SCB4	Considering the shopping scenario, you just experienced, please rate the following statements. - I think that a lot of people bought the Q phone 19.	0.67	
			SCB5	Considering the shopping scenario, you just experienced, please rate the following statements. - I think that many people will buy the Q phone 19 when it becomes available again.	0.94	
Satisfaction with the in-stock/out-of-stock situation (Dependent Variable)	Wallace et al. (2004)	Satisfaction with the out-of-stock situation (Peinkofer, Esper, and Howlett 2016)	SF1	Considering the shopping scenario, you just experienced, please rate the following statements. - Considering everything, how satisfied were you with your overall shopping experience?	0.99	AVE= 0.95 α= 0.97
			SF2	Considering the shopping scenario, you just experienced, please rate the following statements. - Considering everything, how do you feel about your overall shopping experience?	0.96	
Purchase Intention (Dependent Variable)	Spears and Singh (2004)	Individual assessment of future willingness to buy (Spears and Singh 2004)	PI1	How willing are you to purchase the Q phone 19 when it becomes available?	0.96	
			PI2	How willing are you to purchase the Q phone 19 when it becomes available?	0.96	
			PI3	How willing are you to purchase the Q phone 19 when it becomes available?	0.96	AVE= 0.92 α= 0.98
			PI4	How willing are you to purchase the Q phone 19 when it becomes available?	0.96	
			PI5	How willing are you to purchase the Q phone 19 when it becomes available?	0.97	

χ^2 (df)= 94.97 (43); p-value <0.001; CFI= 0.96; RMSEA= 0.086 [0.063 - 0.109]; SRMR= 0.12

*α: Cronbach's alpha

Table 2: Experiment 1 Correlation Matrix (n = 164)

	1	2	3
1. Perceived Scarcity	1		
2. Satisfaction	-0.16*	1	
3. Purchase Intention	0.45**	0.21**	1

Note: *p < 0.01; **p < 0.05.

Analysis and Results

To test hypotheses 1 to 3, we used PROCESS Model 4 (Hayes, 2013), which tests a simple mediation model. The independent variable in the model was a categorical variable that represented the various levels of our treatments. Our treatments had three possible values, i.e., 1 for no post-stockout scarcity disclosure, 2 for disclosures through the firm's website, and 3 for multi-channel post-stockout scarcity disclosure. Helmert coding helps contrast the effects by comparing each group to the mean of the subsequent levels, and was used to code this variable (Sundström, 2010). This analysis aimed to validate the effect of post-stockout scarcity disclosure on consumers' perceived scarcity and consumer outcomes such as consumer satisfaction and purchase intention. Furthermore, we tested whether there is an additional effect if the disclosure comes from multiple sources. As there are two DVs of interest, the model is estimated twice, using consumer satisfaction (SF) and purchase intention (PI) as the respective outcome variables. The regression results from the two estimations are summarized in Table 3. Table 4 shows the indirect effect of the treatments on satisfaction and Purchase Intention through perceived scarcity.

Table 3: Regression results from Process model 4 analysis

N=163; DV=	Perceived Scarcity		Satisfaction		Purchase Intention	
Adj R-sq	0.03		0.05		0.24	
F	2.42		2.55		16.44	
P	0.09		0.06		0.00	
Antecedents	**Coeff**	**Se**	**Coeff**	**Se**	**Coeff**	**Se**
X1(β_1)	0.33**	0.15	0.14	0.16	-0.09	0.14
X2(β_2)	0.02	0.18	-0.2	0.19	-0.39**	0.16
Perceived Scarcity(β_3)			-0.21**	0.08	0.48**	0.07
Constant(β_0)	0.02	0.07	0.02	0.26	0.00	0.07

Note: *p < 0.01; **p < 0.05.

Table 4: Indirect effects from Process model 4 analysis

Relative indirect effects	Treatment (TR)	Effect	BootSE	BootLLCI	BootULCI
TR→ Perceived scarcity → PI	X1	0.159	0.085	0.013	0.344
	X2	0.010	0.085	-0.150	0.192
TR → Perceived scarcity → SF	X1	-0.069	0.043	-0.168	-0.001
	X2	-0.004	0.040	-0.092	0.073

From the results, we found that post-stockout disclosures (X1) positively affect consumer perceived scarcity, thus founding support for hypothesis H1 ($\beta_1 = 0.33$, $p < 0.05$). However, H2, which hypothesized that as the number of channels of post-stockout disclosures (X2) increased, consumers' perceived scarcity increased, is not supported ($\beta_2 = 0.02$, $p = 0.91$).

Table 4 suggests that both the path Post-stockout disclosures → Perceived Scarcity → Purchase intention and Post-stockout disclosures → Perceived Scarcity → Satisfaction were significant. However, interestingly the mediation relationship through perceived scarcity on satisfaction was in the opposite direction to what was hypothesized through H3a and thus is not supported (Effect = -0.69, BootLLCI = -0.168, BootULCI = -0.001). It was found that as perceived scarcity increased, satisfaction decreased (β_3= -0.21, $p < 0.05$).

Nevertheless, as consumers perceived scarcity increased, consumer purchase intention in a post-stockout situation increased ($\beta_3 = 0.48$, $p < 0.05$). The mediation effect, i.e., hypothesis H3b, which suggests that consumer perceived scarcity will mediate the positive relationship between post-stockout disclosures and consumer purchase intention with the post-stockout situation, was supported (Effect = 0.159, BootLLCI = 0.013, BootULCI = 0.344). Table 5 provides a summary of our hypotheses testing.

Table 5: Hypothesis and Results

H1:	The presence of post-stockout disclosures positively affects consumer perceived scarcity.	Supported
H2:	As the number of channels of post-stockout disclosures increases, consumer perceived scarcity increases.	Not Supported
H3a:	Consumer perceived scarcity will mediate the positive relationship between the presence of post-stockout disclosures and consumer satisfaction with the post-stockout situation.	Not Supported – Opposite Direction
H3b:	Consumer perceived scarcity will mediate the positive relationship between the presence of post-stockout disclosures and consumer purchase intention with the post-stockout situation.	Supported

Experiment 1: Discussion of Results

The findings of the experimental analyses offer valuable insights into the role of perceived scarcity in shaping consumer responses to stockouts. First, in line with prior literature (Jang et al., 2015; Song et al., 2015; Aggarwal et al., 2011), we establish that in our contextual setting a positive relationship exists between the presence of post-stockout disclosures and consumers' perception of scarcity. Consumers perceived that the products had limited supply, which was insufficient to meet the demand for the product.

Marketing literature suggests that scarcity enhances the perceived value of products, resulting in greater product desirability and higher satisfaction (Aggarwal et al., 2011; Cook & Yarchisin, 2017; Lynn, 1991). However, in the context of a stockout situation, we found opposing evidence. Specifically, we found a negative relationship between perceived scarcity and consumer satisfaction with the post-stockout situation—that is, stockout disclosures led to more dissatisfaction with the stockout owing to the perception of increased scarcity. Our finding is consistent with Peinkofer et al. (2016), who also found a negative relationship between the disclosure of limited inventory and satisfaction in a pre-stockout scenario. Peinkofer et al. (2016) argue that when the supply of the desired product is restricted or limited, consumers are more dissatisfied with stockouts because they think they lost to others who could buy the product before the stockout.

The most intriguing finding relates to the relationship between perceived scarcity and purchase intentions. Our results showed that, even though an increase in perceived scarcity in the presence of post-stockout disclosures decreased satisfaction, it increased consumers' purchase intention for the product. This finding indicates that even though consumers feel dissatisfied with being unable to purchase the product initially, they continued to be interested in purchasing the product once it was back in stock.

Lastly, we did not find a significant difference in consumer outcomes when consumers received the stockout signal through multiple channels. Specifically, we found no significant difference in perceived scarcity when the stockout signal was received only through the website or when consumers received the same stockout signal through multiple channels. This finding is contrary to our theoretical predictions, as we did not see signal effectiveness increase as the number of congruent signals increased (Janney & Folta, 2003). These results may suggest that as all signals were alike, the repeated signal within a short span had the same effect on consumers as a single signal had. Consumers might combine the same signal sent through different channels into a single signal rather than considering the signals as a set.

Experiment 1 offers valuable insight into the role of perceived scarcity on consumer satisfaction and purchase intention at a single point in time. Past literature on stockouts has used similar between-subjects designs while looking at the effect of stockouts on consumer behavior. However, a stockout can last from a few days to a considerable period (Anderson & Fitzsimons, 2006; Jing & Lewis, 2011). Just as the signal's effectiveness can change over time (Connelly et al., 2010), consumers' response can change. Thus, to help managers mitigate negative effects, studying the temporal effects of stockout signals is of utmost importance, as is studying how consumers' perceived scarcity, satisfaction, and purchase intention change with continued exposure to the stockout signal. Signaling theory experts have also called for study of the effect of signals over time on receivers (Connelly et al., 2010). However, allthough studies in consumer behavior have long advocated using temporal cues, temporal designs are rare (Hornik, 1984). Hence, next we focus on the effect of post-stockout signals over time on consumer reactions.

The Temporal Effect on Consumer Reaction to Stockouts

Stockouts resulting from limited availability can often persist over a long time. When a firm uses post-stockout disclosures that showcase the scarcity of the product, and the stockout persists over a long time, consumers are exposed to the same scarcity signals whenever they try to purchase the product. Signaling theory suggests that if the "quality" (i.e., the signal sender's ability to fulfill the needs and demands of the signal receiver) communicated through the signal is not ratified by the signaler's actions over time, the reliability of the signal ,the credibility of the signaler and the effectiveness of the signal decreases (Busenitz et al., 2005; Sanders & Boivie, 2004; Janney & Folta, 2003). Therefore, if stockouts persist over time and consumers are exposed multiple times to the same scarcity signals, consumers start doubting the firm's credibility and its ability to fulfill their demand for the product. As the credibility of the scarcity signal decreases, it’s reliability and effectiveness on the consumer decreases (Busenitz et al., 2005; Sanders & Boivie, 2004). Thus,the consumer’s perceived scarcity for the product decreases. As the consumer starts doubting the firm's reliability, it associates the stockout with the firm's supply chain failure rather than the product's scarcity.

As consumers start questioning the firms’ scarcity claims, consumer dissatisfaction with the stockout situation increases as they no longer link the stockout with the scarcity of the product. As a result, consumers’ product desirability also decreases, decreasing consumers’ purchase intention. With these arguments, we lay down our next hypothesis:

H4: As the number of attempts made by consumers to purchase the stocked-out product increases, consumers’ a) perceived scarcity, b) consumer satisfaction, and c) purchase intention decreases.

Experiment 2

To study the effect of the passage of time on the perceived scarcity, satisfaction with the out-of-stock situation, purchase intention, we used a within-subject analysis over time. For this experiment, three separate studies, each separated by a period of two days, were used. In Experiment 1, we could not find any significant difference between scarcity signals through post-stockout disclosures from a single channel (website only) and congruent signals from multiple channels (website, social media, and news). Thus, all the respondents in Experiment 2 were exposed to post-stockout disclosures through websites only. Similar to Experiment 1, consumers perceived scarcity, satisfaction, and purchase intention were collected in response to the treatment on three occasions.

Respondents were inducted into the three studies using Amazon Mturk via the Cloud Research platform (Litman et al., 2017). Respondents were informed that this experiment is a part of three separate studies spread over a period of five days. Respondents were paid $0.5, 0.75, and $1 for completing studies 1, 2, and 3, respectively. On completing the three studies, respondents were paid an additional bonus of $1 to ensure retention. 114, 77, and 58 respondents completed study 1, study 2, and study 3. 58 respondents completed all three studies. Similar to Experiment 1, attention checks, manipulation checks were included. However, none of our final sample respondents failed these checks. The respondent's average age was 38, median gross income was between $30,001-50,000, median education level was a 4-college graduate, and 31% of the respondents were female.

CFA Analysis

With the finalized sample, the three variables of interest: perceived scarcity, purchase intention, and satisfaction with the stockout situation, were again assessed for reliability via Cronbach's alpha using a three factor CFA model. The fit statistics supported our measurement model (Kline, 2005) with $\chi 2 = 90.99$, df = 43, comparative fit index (CFI) = .98, root mean square error of approximation (RMSEA) = .08 (90% confidence interval: 0.06; 0.10), and standardized root mean square residual (SRMR) = .13. The average variance extracted (AVE) was calculated to establish convergent validity, and Cronbach's α was calculated for reliability analysis. The AVE for each factor exceeded the recommended threshold of .5 (Fornell & Larcker, 1981), and all three α values exceeded .8 (Nunally & Bernstein, 1994). Furthermore, The AVE of each factor was higher than the phi square correlation of each factor pair, suggesting discriminant validity (Fornell & Larcker, 1981). Upon confirmation of the measurement model, the mean-centered factor scores are extracted using the CFA model and the Bayes estimator (Calantone et al., 2017).

Analysis and Results

To test Hypotheses 4a, 4b, and 4c, we used SPSS GLM repeated measure analysis which performs a within-subject analysis by comparing means over time. Table 7 provides the within-subject contrast and the pairwise comparison results of the variables of interest, i.e., perceived scarcity, satisfaction, and purchase intention. Our analysis found support for H4a, which hypothesized that in the presence of post-stockout disclosures, consumers' perceived scarcity decreases with the number of interactions (Mean square= 0.89, $p < 0.05$). However, H4b, which hypothesized that in the presence of post-stockout disclosures, consumers' satisfaction decreased with the number of interactions, was not supported (Mean square= 0.55, $p = 0.16$). Nonetheless, we found support for H4c, which hypothesized that in the presence of post-stockout disclosures, consumers' perceived purchase intention decreased with the number of interactions (Mean square= 2.4, $p < 0.05$). Table 8 provides a summary of finding from the hypotheses testing.

Table 7: Time effect on Consumer Outcomes

Tests of Within-Subjects Contrasts							
Variable	**Source**	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Satisfaction	Time	0.55	1.00	0.55	1.99	0.16	0.03
	Error	15.82	57.00	0.28			
Purchase Intention	Time	2.40	1.00	2.40	12.99	0.00	0.19
	Error	10.53	57.00	0.18			
Perceived Scarcity	Time	0.89	1.00	0.89	7.46	0.01	0.12
	Error	6.79	57.00	0.12			

Pairwise Comparisons			
	(I) Time	**Mean Difference (I-J)**	**Std. Error**
Satisfaction	1-2	-0.12	0.09
	1-3	0.14	0.10
Purchase Intention	1-2	0.19*	0.06
	1-3	0.29*	0.06
Perceived Scarcity	1-2	0.11	0.06
	1-3	0.18*	0.06

Based on estimated marginal means

* The mean difference is significant at the .05 level.

Figure 2: Effect of time on consumer response

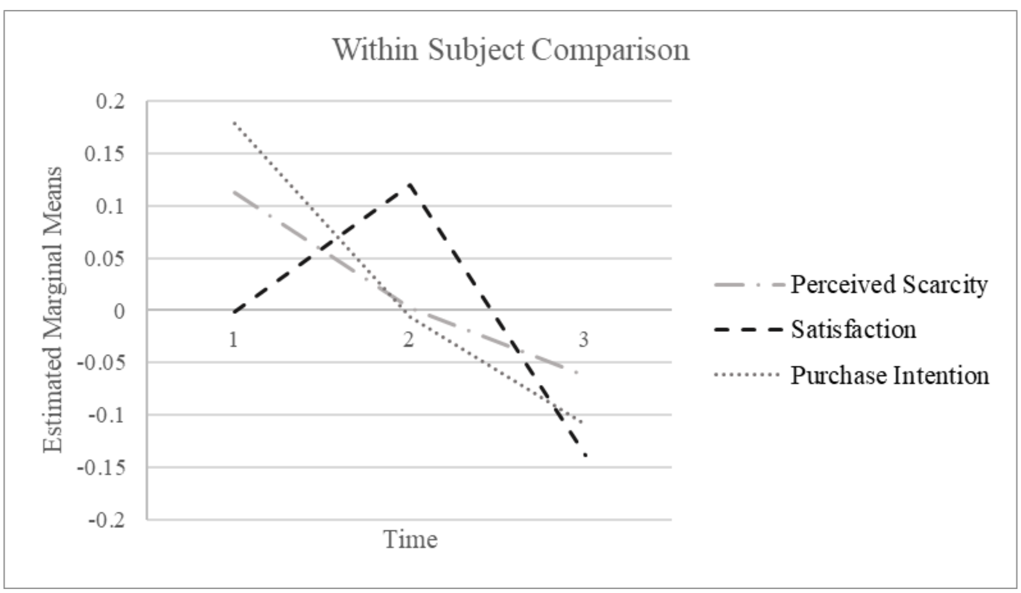


Table 8: Hypothesis and Results

H4a:	As the number of attempts made by consumers to purchase the stocked-out product increases, consumers' perceived scarcity decreases.	Mean Difference: -.175*	Supported
H4b:	As the number of attempts made by consumers to purchase the stocked-out product increases, consumer satisfaction decreases.	Mean Difference: -0.14	Not Supported
H4c:	Hypothesis 4: As the number of attempts made by consumers to purchase the stocked-out product increases, consumers' purchase intention decreases.	Mean Difference: -.288*	Supported

Experiment2: Discussion of Results

Our results in this second experiment revealed that even though consumers' perceived scarcity and purchase intention increased after the first exposure to post-stockout scarcity disclosures, both perceived scarcity and purchase intention significantly decreased with time (5 days), as predicted by signaling theory. Specifically, the strength or effectiveness of the post-stockout scarcity disclosure (signal) on the consumer (receiver) decreases over time (Janney & Folta, 2003; 2006) as the credibility of the retailer (signaler) regarding the potential scarcity of the product starts to be questioned by the consumer. As consumers doubt the product's scarcity, they no longer want to purchase the product. It is noteworthy that an extended stockout did not significantly impact satisfaction levels. As found in experiment 1, satisfaction with the stockout situation was already reduced due to product unavailability in the initial period, and levels did not change significantly over time. As such, consumers who were initially dissatisfied with the stockouts situation maybe because they thought they lost to others who could buy the product before the stockout continued to remain dissatisfied to the same extent as they did not see the product come back to stock. Altogether, these results indicate that while retailers can still leverage disclosures to retain – dissatisfied – customers after a stockout, this benefit is short lived: if products are not back in stock in a timely manner, consumers will shop for the product elsewhere.

Research Implications And Contributions

Theoretical Implications

Our research offers important contributions to the growing consumer-centric supply chain management literature, in which consumer insights are the foundation of supply chain design and operational strategies (Ha et al., 2015; Peinkofer et al., 2016). Indeed, consumers are increasingly acknowledged as critical and active participants in supply chain functions (Ha et al., 2015). Our study contributes to this stream of research by integrating consumer behavior and psychology foundations to provide a deeper understanding of consumer behavioral responses to post-stockout disclosure. Specifically, we complement and extend existing consumer-centric literature that focuses on pre-stockout information disclosure (Peinkofer et al., 2016; Park et al., 2020).

Research in this stream has mostly looked at the negative outcomes of stockouts and pre-stockout strategies to prevent this negative consumer behavior (Kim & Lennon, 2011; Peinkofer, Esper, & Howlett, 2016; Park et al., 2020). However, many retailers do not have control over the timing of their products' stockouts. Our study provides a possible strategy to control the negative consumer outcomes linked with stockouts even after the stockout has manifested. Our study adds post-stockout disclosure to the list of other (potentially more costly) strategies to counter negative consumer behavior, such as offering price promotions to alter consumer expectation, in-store "save the sale" tactics, and shipping directly to consumers as a way to counter negative consumer behavior (Peinkofer et al., 2015; Peinkofer et al., 2021; Rao et al., 2011).

Second, our study highlights that even though satisfaction with the shopping experience decreases with post-stockout disclosures that highlight the scarcity of the product, the purchase intention for the product increases. While the finding of a negative effect on satisfaction owing to heightened scarcity perceptions was against the predictions of our proposed model, it was consistent with prior supply chain management research that investigated the role of inventory disclosures before stockouts (Peinkofer et al., 2016). We posit that the consumer's increased desirability for the product may explain a decrease in satisfaction with the shopping experience in the presence of the post-stockout scarcity disclosures. When consumers cannot buy these highly desirable products because of stockouts, their satisfaction with the shopping situation may decrease. Moreover, with greater desirability, consumer anticipation for the product might also rise, leading consumers to postpone purchase until it is back in stock. This reaction might explain the increased purchase intention in the presence of scarcity disclosures.

This finding of an opposite direction of the relationship between perceived scarcity with satisfaction and purchase intention is interesting. According to the pre-stockout literature, one mechanism that may explain greater dissatisfaction with stockouts may be increased consumer competition, which could lead consumers to think they lost to others who could buy the product before the stockout (Peinkofer et al., 2016). However, with the scarcity of the product, even though consumers feel dissatisfied because they cannot purchase the product at that time, they continue to be interested in purchasing once the product is back in stock. That is, perceived scarcity might heighten consumer anticipation for the product, increasing dissatisfaction with the shopping experience while fueling intentions to purchase the product when available.

Third, our study contributes to signaling theory by deriving middle-range theory (Craighead et al., 2016; Stank et al., 2017) to show that post-stockout disclosures indeed act as a signal and can help retailers to shape and influence consumer perceptions and behavior. In addition, in our context, we show that in contrast to the predictions of signaling theory, sending multiple congruent signals does not enhance the effectiveness of the signal. Signal congruence has been found to affect consumers' evaluation of a public offering or merger and acquisition (Janney & Folta, 2003; 2006) or the reputation and status of a firm's founders, interfirm alliance, and corporate sustainability reputation (Stern et al., 2014; Mindrut et al., 2015; Lin & Tseng, 2016; Drover et al., 2018). However, the absence of this effect in our research highlights the context specificity of signaling theory. Furthermore, our research showed that as consumers repeatedly received the same stockout signal over a specific time period, both perceived scarcity and purchase intention decreased while dissatisfaction remained constant. Hence, the temporal effect of congruent stockout signals appears to be nuanced and affect consumer sentiments and behaviors differently.

Managerial Implications

Traditionally, retail managers have considered stockouts to be "lemons," detrimental to their performance in terms of sales, inventory management, and customer satisfaction. However, our research shows that post-stockout disclosures that highlight the scarcity of a product can enhance consumers' purchase intentions, even when consumers are dissatisfied with a stockout. The results indicate that sharing information about the low supply of a product can lead consumers to attribute the stockout to the uniqueness of the product rather than the retailer's supply chain failures—a perception that in turn can mitigate negative consumer behavior. Therefore, these results provide empirical support for and validation of the actions of retailers such as Adidas and Apple, who frequently highlight the scarcity of their products during stockouts.

Recently, Microsoft Xbox and Sony Playstation used various disclosures through different channels, such as their website, social media accounts, and general media, to highlight the chip shortage and the resulting stockouts. We argue that these disclosures played a key role in increasing demand during the 2021 holiday season (Chen, 2021). In addition, by using a generic brand product in our experiment, we expand on these industry examples to demonstrate that different retailers can broadly use such disclosures, regardless of their current market standing or brand value. Overall, our research offers managers a strategy to turn the "lemons" from the stockout into "lemonade."

Our findings also indicate that, in a post-stockout context, perceived scarcity positively affects purchase intention even though it negatively affects satisfaction. This result suggests that retailers should not rely solely on the consumer satisfaction index while strategizing their response to stockouts but should incorporate consumers' purchase intention into their analysis, since with respect to scarce products decreased satisfaction may not lead to decreased purchase intention. In the presence of scarcity disclosures, a dissatisfied customer may not translate to loss of a sale.

However, managers cannot rely on the same disclosures for a long time after the initial stockouts occur, as our results indicate that consumers' perception of scarcity and purchase intention are reduced over time if the stockout persists. This finding may suggest that, over time, consumers could consider the disclosures from the retailer as unreliable and, as a result, start to associate the stockout with failure of the retailer to secure the products. To mitigate this effect of time and support their initial messaging with action, managers may want to keep consumers informed about what they are doing to bring the product back in stock, since although consumer purchase intention decreased with time, dissatisfaction levels remained unchanged. This finding strengthens our suggestion that retailers should not rely solely on the consumer satisfaction index but, in the presence of scarcity disclosures, should use consumers' purchase intention instead.

Limitations and future research

We recognize that like any research, our study has limitations. In line with prior literature, our study utilized an existing generic high-value product (Peinkofer et al., 2016). However, studies have found that a differential effect occurs regarding consumers' perceived scarcity, depending on product type, brand reputation, and product age (Emmelhainz et al., 1991; Campo et al., 2000; Stock & Balachander, 2005; Balachander & Stock, 2009; Gierl & Huettl, 2010), as well as whether the product is established or new (Shi et al., 2020). Future studies could investigate how, in the presence of a stockout, consumers' perceptions of scarcity and associated outcomes vary depending on these dimensions. Second, our research focused on messaging that indicated a supply-induced scarcity. Future research could investigate the effect of demand-induced scarcity messages on consumer outcomes. Third, we recognize that consumers receive signals from various sources and these signals are sometimes inseparable. While multiple congruent signals can increase signal strength (Stern et al., 2014; Mindrut et al., 2015; Lin & Tseng, 2016; Drover et al., 2018), with post-stockout scarcity disclosures, we did not find that multiple congruent signals increased signal strength. Future research is needed to explore the various types of signals and the link between signal congruence and signal strength perceived by the receivers.

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Appendix

Scales

Perceived Scarcity (Wu et al. 2011) - 11-point Likert scale

Please specify how much these statements represent you personally.

1. I don’t like situations that are uncertain.
2. I find that a well-ordered life with regular hours suits my temperament.
3. I feel uncomfortable when I don’t understand the reason why an event occurred in my life.
4. I don’t like to go into a situation without knowing what I can expect from it.
5. When I have made a decision, I feel relieved.
6. When I am confronted with a problem, I’m dying to reach a solution very quickly.
7. I would quickly become impatient and irritated if I would not find a solution to a problem immediately.
8. I don’t like to be with people who are capable of unexpected actions.
9. I dislike it when a person’s statement could mean many different things.
10. I find that establishing a consistent routine enables me to enjoy life more
11. I enjoy having a clear and structured mode of life.
12. I dislike unpredictable situations.

Satisfaction with the in-stock/out-of-stock situation (Wallace et al. 2004) - 11-point Likert scale

Considering the shopping scenario, you just experienced, please rate the following statements.

1. Considering everything, how satisfied were you with your overall shopping experience?
2. Considering everything, how do you feel about your overall shopping experience?

Purchase intention (Spears and Singh 2004) - 11-point Likert scale

How willing are you to purchase the Q phone 19 when it becomes available?

1. Never/definitely
2. Definitely do not intend to buy/definitely intend
3. Very low/high purchase interest
4. Definitely not buy it/definitely buy it
5. Probably not/probably buy it

Checks

Manipulation Check 1

Based on the scenario you experienced, through which channel(s) of communication did you learn that the Q phone 19 is currently out of stock.

a) Only the website

b) Website, Online news, and social media (Twitter)

Manipulation Check 2

Based on the scenario you experienced, please identify the picture of the website you saw.

Realism Check

The shopping situation described was realistic.

Strongly disagree to Strongly agree

Instructional Manipulation Check

In order to ensure that data is being collected correctly, please answer the following question: Did you have breakfast with a dinosaur this morning?

Yes No

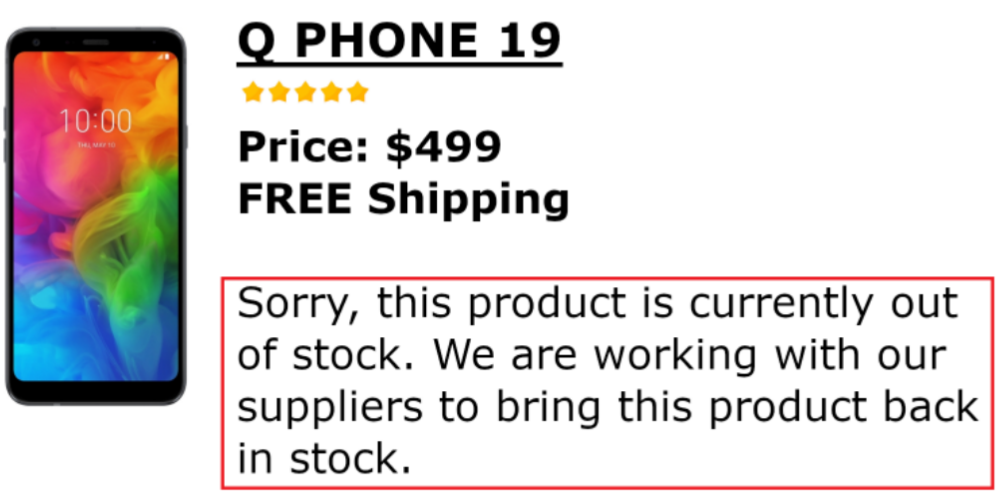
Scenario IntroductionTreatments

Now, please imagine yourself in the following shopping situation: You are in the market to buy a new smart phone. This is the latest Q PHONE 19. It has the latest specifications comparable with other high end phones being offered on the market. The price of the product also matches with your allocated budget.

Treatments:

Treatment 1- Control

You visit the website of Q Electronics in order to buy the Q phone 19. The website shows the following information.



Treatment 2- Disclosure through website

You visit the website of Q Electronics in order to buy the Q phone 19. The website shows the following information.

Treatment 3 Additional disclosure- News

Unable to purchase the Q-phone from Q Electronics' website, you decide to visit an online news website to check the latest news. You come across the following news article.

Q Electronics sells out of its newly launched Q phone 19

The company's spokesman Peter Path said in a statement that as the new Q phone 19 is a high-quality limited supply product, their online store is currently out of stock of the phones. Q Electronics said that it was working with its suppliers to bring this product back in stock.

Treatment 3 Additional disclosure-social media

Table 6: Perceived Quality Analysis

Perceived Quality	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2.81	2.00	1.41	0.44	0.65
Within Groups	80.67	25.00	3.23		
Total	83.48	27.00			

Essay 2: Hurry Up! Better to Get it Now Than be Sorry Later: A Study on the Effect of Product Rationing on Stockpiling Propensity Before Natural Disasters.

Abstract

During natural disasters, retailers often aim to reduce consumer stockpiling behavior and promote equitable distribution by employing product rationing, i.e., placing quantity limits on critical commodities. However, extant marketing literature has shown that such quantity limits yield an anchoring effect which increases consumer purchases relative to normal times. Due to these contradictions, this study investigates how limiting purchase quantities during disasters impacts consumer stockpiling propensity. We also analyze how retailers' signs advocating social norms or socially acceptable behavior affect consumer stockpiling behavior. Using a scenario-based experimental design and 400 valid responses through the Amazon Cloud research platform, we found that, in presence of an impending natural disaster, two mechanisms take place. First, when consumers' needs were less than the retailer's set purchase limit, the purchase limit positively and directly affected consumer stockpiling propensity due to the anchoring effect. Additionally, under the same premise, there was also a negative indirect effect of the retailer's set purchase limit on consumer stockpiling propensity, mediated by consumer perceived future regret. Though we could not find any significant effect of social nudges in the presence of a purchase quantity limit, when no limits were placed, social nudges significantly reduced consumer stockpiling propensity.

Keywords: stockpiling; disasters; scarcity; experimental design; anchoring effect

Introduction

When the recent pandemic hit, consumers did what they usually do before natural disasters; they stockpiled (Maryland Smith Research, 2020). This led to long lines outside retail stores, empty shelves, and consumers unable to fulfill their basic needs of food, toiletries, and medicine, which became the face of this disaster (Telford & Bhattarai, 2020 ; Hanbury, 2020). Though the pandemic may be considered a once-in-a-lifetime event, localized disasters such as hurricanes, snowstorms, and earthquakes have led to similar localized retail disruptions across the USA (Holguín-Veras et al., 2012; Morrice et al., 2016).

Due to the vivid accounts of human suffering associated with the retail distribution of essential supplies during a natural disaster, the operations management literature has considered several retailer-level strategies to maintain product availability (Gabler et al., 2017). Retailers temporarily collaborate with other public and private organizations, including local, state, and federal governments (such as FEMA), military, charities, nonprofits, and other retailers (Leiras et al., 2014; Gabler et al., 2017). The success of such collaboration involves alignment and adjustment of mutual goals and allocation and governance over mutual resources (Gabler et al., 2017). On an operational front, demand during disasters is highly volatile, exasperated by rapidly changing operating conditions, and rapidly supplying commodities to those suffering from natural disasters become vital for retailers and other public and private partners (Ambulkar et al., 2015). A retailer relies on hurricane information updates to plan inventory while setting expectations regarding their operating costs and service level (Lodree & Taskin, 2009; Rawls & Turnquist, 2010; Taskin & Lodree, 2010; Taskin & Lodree, 2011; Lodree et al., 2012; Davis et al., 2013; Morrice et al., 2016). However, natural disasters are difficult to forecast accurately and beyond the retailer's control (Kleindorfer & Saad, 2005; Hu & Sheu, 2013; Hendricks et al., 2018). Hence, retailers often switch to a "war room" approach running in a centralized fashion to push critical commodities out to the forecasted places, starting well before the disaster strikes (Banjo, 2012; Ambulkar et al., 2015; Morrice et al., 2016). The forecasted path, the intensity, and the region of the impact of the disaster guide the movement of goods and preparedness of these organizations (Salmeron & Apte, 2010; Rawls & Turnquist, 2010; Lodree et al., 2012; Morrice et al., 2016).

Furthermore, retailers employ storefront strategies such as product rationing at stores projected to be hit the hardest by these disasters. Product rationing refers to the controlled distribution of scarce goods to artificially control demand and match it to the supply during times of limited supply (Stan, 2013). During disasters, stores in affected areas often ration select products as a means to achieve two objectives: prevent consumer stockpiling and ensure product availability to the maximum number of consumers until more inventory arrives (Hinderaker & Schlegelmilch, 2020). Stockpiling is the practice of accumulating large private stocks of goods in times of uncertainty or perceived supply threats by consumers (Sterman & Dogan, 2015; Pan et al., 2020)[1]. Stockpiling propensity of a consumer can be defined as the inclination of the consumer to buy beyond their need (Pan et al., 2020). In times of natural disasters, the possibility of product scarcity can affect consumer attitude and behavior (Billore & Anisimova, 2021), thus stimulating stockpiling. Stockpiling can destabilize supply chains and increases stockout risk (Sterman & Dogan, 2015; Pan et al., 2020). Stockpiling can also affect product availability for

[1] Stockpiling panic buying and hoarding are often used interchangeably used in the literature. However, according to ADAA, they have a different meaning. While hoarding refers to an accumulation of large stock during normal times due to an underlying mental disorder, panic buying occurs because of the anxiety associated with an impending crisis. However, stockpiling is normal human behavior employed during times of uncertainty. We understand that there can be an overlap between these responses; however, we concentrate only on stockpiling to reduce the complexity involved in the analysis.

https://adaa.org/learn-from-us/from-the-experts/blog-posts/consumer/hoarding-stockpiling-panic-buying-whats-normal the disadvantaged in the communities and exasperates human suffering (Fothergill & Peek, 2004). Thus, maintaining a critical product supply gains utmost importance for the retailer in the affected community (Ozbay & Ozguven, 2007; Taskin & Lodree; 2010).

While retailers aim to reduce consumer stockpiling by employing product rationing by placing quantity limits on critical commodities, studies in the fields of behavioral economics and marketing have actually linked such quantity limits with creating anchors in the mind of consumers and, as a result, increasing demand (Wansink et al., 1998; Carlson, 2020). The argument is that these "purchase quantity limits" create an initial reference anchor that biases consumer decisions towards that initial anchor (Tversky & Kahneman, 1974). This effect is called the anchoring effect. According to the anchoring effect, in the presence of a visible anchor, such as a quantity limit sign from the retailer, consumers make decisions based on comparison with the anchor (observed purchase quantity limit) and change their perceived demand accordingly (Wansink et al., 1998; Furnham & Boo, 2011). Marketing literature has highlighted that placing purchase quantity limits products increases sales for various products such as new, exclusive, or discounted (Wansink et al., 1998; Howard et al., 2007; Chernev, 2008; Ku, 2019).

TABLE 1: Purchase Quantity Limit Vs. Consumer Needs

Scenario	**Anchoring effect**	**Consequence**
Scenario-1: Consumer needs > Purchase limit	No, as buying is restricted. Stockpiling is restricted.	✓ Consumers buy at the purchase limit ✓ More consumers were able to buy the product ✓ Consumer needs were not fulfilled
Scenario-2: Consumer needs < Purchase limit	Yes, consumers buy more than they need, and their stockpiling propensity increases.	✓ Stockpiling propensity increases ✓ Fewer consumers were able to buy the product ✓ % of consumers whose needs were fulfilled increases

When the limits set by the retailer are lower or the same as the average needs of the consumer, the consumers have no option but to buy at the limit as they have to fulfill their necessities. However, when the purchase quantity limits are higher than the consumer's needs, an anchoring effect may unintendingly lead consumers to buy more than their needs and towards the anchor, making it interesting to study (refer to Table 1). Thus, even though retailers may try to reduce stockpiling and fulfill the needs of a maximum number of consumers during disasters, having the purchase quantity limits higher than the needs may lead to unintended stockpiling.

Considering these conflicting outcomes of product rationing, we aim to close this gap by investigating the product rationing's effectiveness as a retailer's storefront strategy before natural disasters to reduce consumer stockpiling. Primarily we look at the scenario where the purchase quantity limits are higher than the consumer needs as we recognize that when the limits are lower, consumers always buy at the limit. In our research, we answer the three questions in a natural disaster setting, considering the limits to be higher than the needs of the consumer:

1. How do purchase quantity limits employed by a retailer during disasters impact consumers' stockpiling behavior?
2. Does consumers' perceived scarcity play a role in this relationship between the retailer's purchase quantity limits and consumers' stockpiling behavior?

Some retailers also employ signs highlighting socially acceptable behavior before natural disasters. Through these signs, retailers try to make the consumers think about others in their community and thus not stockpile. Highlighting socially acceptable behavior falls is referred to as social norms in the literature. Social norms refer to the customary rules that guide expected individual behavior in groups and societies (Cialdini et al., 1991). Social norm nudges or social nudges refer to subtle behavioral interventions through advertisements, policy, or disclosures intended to induce voluntary cooperation in social dilemma situations (Thaler & Sunstein, 2009). Thus our third question is

3. How do signs from the retailer advocating social norms or socially acceptable behavior affect consumer stockpiling?

Through this study, we want to contribute to three major streams of literature. First, our research will contribute to the micro-level disaster management literature (Gupta et al., 2016; Pan, 2020) by developing an empirically grounded work on disaster operations (Pedraza-Martinez & Van Wassenhove, 2016). Specifically, we want to contribute to the growing literature on consumer stockpiling behavior and retailer response before natural disasters (Morrice et al., 2016; King & Devasagayam, 2017; Pan et al., 2020). Past literature in this space has established that consumers' attributes (such as disaster experience and household income) and retailers' attributes (retail network and product assortment carried) can affect stockpiling propensity of the consumer (Pan et al., 2020). Our research will add to this literature base by studying the effectiveness of retailers' in-store strategies of purchase quantity limits and messages highlighting acceptable social norms against stockpiling behavior.

Second, our study will be the first study that looks at the effect of product scarcity resulting from a natural disaster on the anchoring effect established with purchase quantity limits. Traditionally, marketing research has investigated the role of quantity limits with the objective of driving sales, which is a different context than disaster management. Our study will be the first to explore the effects of purchase quantity limits in the context of an upcoming disaster without any price discount on the offer. As such, this research will contribute to behavioral operations research that has linked individual-level factors such as mood, knowledge, experience, expertise, personality, cognitive ability, as well as external factors such as incentives and warnings that influence the anchoring effect (Furnham & Boo, 2011).

Finally, our study will highlight the role of social norm nudges or simply social nudges through disclosures on consumer stockpiling behavior in a retail environment. Our research will add to the growing literature base that has found nudges to be beneficial in social contexts, such as lowering energy consumption (Brandon et al., 2019), dealing with corruption (Köbis et al., 2019), and improving tax collection (Crago et al., 2020).

Our study offers significant managerial implications as it will investigate the effectiveness of product rationing in decreasing consumer stockpiling and enabling equitable distribution in a disaster management setting. Moreover, it will help store managers choose the appropriate purchase quantity limit to ensure the most equitable product distribution. Lastly, our research will empirically test the effectiveness of social norm nudges as a mechanism to control stockpiling in the presence of a purchase quantity limit.

Literature Review

Stockpiling as a consumer response to natural disasters.

Disruptions can be defined as unplanned and unanticipated events that impede the normal flow of goods and materials within a supply chain (Svensson, 2000; Stauffer, 2003; Kleindorfer & Saad, 2005). Disruptions in a retail environment can be due to transportation or supply issues such as late shipment of inbound materials from suppliers or transportation providers' errors in picking up shipment volumes (Giunipero & Eltantawy, 2004; Wilson, 2007; Qi et al., 2010). Disruptions can also result from in-house issues, such as machinery failures at a warehouse (Rahmani & Ramezanian, 2016). Furthermore, disruptions stem from natural disasters or regulatory and political issues (Ambulkar et al., 2015). Though all kinds of disruptions significantly affect a retailer's functioning, natural disasters pose the most serious challenge as they are outside the control of a firm or its supply chain. Consumers are more aware of disruptions due to natural disasters as more information is available in the public domain through media and government agencies (Miles & Morse, 2007).

During or just before such disruptions, consumers become more susceptible to stockpiling. Popular press and practitioner studies have attributed several drivers of such behavioral responses such as herd mentality, mass behavior, lack of trust in the government response, perceived scarcity, or simply universal helplessness arising from natural disasters (Bouffanais & SunSun, 2020; Sala, 2020; Loxton et al., 2020; Billore & Anisimova, 2021). Recently researchers have suggested that readily available information about the disaster increases consumers' perceived scarcity of essential commodities, leading to increased stockpiling (Pan et al., 2020). They have also argued that as consumers' perceived risk and uncertainty increase before natural disasters, they stockpile necessary products to minimize their perceived losses during product unavailability (Pan et al., 2020).

In addition, consumer behavior research has found that consumer attributes such as household incomes and disaster experiences can impact stockpiling propensity (Pan et al., 2020). Household income is positively linked with stockpiling as individuals with higher income are more capable of purchasing emergency supplies in the face of a natural disaster. For example, Florida's household hurricane preparedness is strongly related to homeownership, residence type, and household income (Baker, 2011). However, the literature on the effect of consumers' prior experience on consumers' stockpiling propensity provides conflicting results. People with more hurricane experience tend to have a greater awareness of hurricane hazards, making them more inclined to stockpile during hurricanes (Trumbo et al., 2011). However, previous hurricane experiences may also have a diminishing effect on consumer stockpiling in disaster-prone areas since those consumers may have already stockpiled in anticipation of the storm as opposed to last-minute preparations (Trumbo et al., 2011; Beatty et al., 2019).

Academic literature has also found that disaster and retailer attribute impact consumers' stockpiling propensity. Disaster attributes such as hazard proximity and hazard intensity have been linked with greater risk awareness among consumers in the affected location and thus greater stockpiling propensity (Moffatt et al., 2003, Peacock et al., 2005; Pan et al., 2020). Furthermore, consumer stockpiling propensity depends on retailers' characteristics, such as their store network and store density, to ensure inventory availability and increase name recognition among consumers, thus attracting increased stockpiling behavior (Gaur et al., 2005; Cachon & Olivares, 2010; Pan et al., 2020). The variety of products offered by retailers provides more options and signals higher inventory availability to the consumer, thus increasing stockpiling behavior (Pan et al., 2020).

Product Scarcity Driven by Consumer Regret

Product scarcity refers to the economic problem of demand for a good exceeding its supply (Shi et al., 2020). When a product is perceived as rare or as having limited availability, consumers understand the product to be scarce. Product scarcity can be unintentional or deliberate. Unintentional scarcity may result from retailers failing to match market demand due to unexpected supply problems or demand increases (Shi et al., 2020). Deliberate scarcity may include retailers intentionally lowering or limiting product supply or disregarding surging market demand (Shi et al., 2020).

Academic literature differentiates between the two types of product scarcity—supply-induced scarcity and demand-induced scarcity (Shi et al., 2020)—each affecting consumer behavior through unique mechanisms. Product attributes such as the product's dispensability for the consumer and its availability to meet anticipated consumer demand can make products susceptible to supply-induced scarcity or demand-induced scarcity. For instance, perceived scarcity increases desirability in high-quality, limited-supply products owing to consumers' need for uniqueness (Brock, 1968; Lynn, 1991; Wu et al., 2012; Roy & Sharma, 2015). Consumers want to differentiate themselves from others and thus seek products that signal their uniqueness (Snyder & Fromkin, 1980; Belk, 1988; Shi et al., 2020). In this vein, consumers value and are attracted to a product to the extent it is unavailable (Brock, 1968), as they tend to link the perceived scarcity of the product with its uniqueness and exclusivity (Szybillo, 1975; Lynn, 1991; Vigneron & Johnson, 1999).

Perceived scarcity can also increase product desirability for bottled water, toilet paper, or canned food, especially during natural calamities (Jones, 1984; Bernheim, 1994; Eisend, 2008; van Herpen et al., 2009). Regret theory provides one of the reasoning for such behavior. Regret theory suggests that in the presence of uncertainty, when a decision-maker has to choose between two prospects, the decision-maker considers what he stands to gain because of a decision and what they might have gained if they had chosen differently (Loomes & Sugden, 1982; Zeelenberg et al., 2002). The decision-maker experiences regret if the outcome of the selected prospect is less desirable than that of the foregone opportunity (Loomes & Sugden, 1982; Zeelenberg et al., 2002). Thus, the decision-maker anticipates the perceived future regret and chooses a prospect that minimizes this regret (Gabler et al., 2017).

Anchoring Effect

Behavioral economics suggests humans always aspire to make rational choices; however, they often use heuristics or cognitive shortcuts (Simon, 1955; Belsky & Golivich, 2010) due to their limited cognitive capabilities. Heuristics can be defined as an 'intuitive, rapid, and automatic system' (Shiloh et al., 2002, p. 417) that helps individuals make judgments under complex situations (Tversky & Kahneman, 1974; Furnham & Boo, 2011). Though heuristics simplify human functions such as estimating probability and predicting values using an intuitive, quick, automatic approach (Tversky & Kahneman, 1974; Shiloh et al., 2002) and can reduce cognitive and time constraints, they can cause severe and systematic errors and add fallacies and biases into decision-making (Tversky & Kahneman, 1974). The anchoring effect is one such heuristic that biases individual decision-making. The anchoring effect states that, during decision making, a suggested starting point while estimating can cause systematic bias due to insufficient adjustment away from that initial suggested point (otherwise called "anchor") (Tversky & Kahneman, 1974). In the presence of an initial anchor through a hint or suggestion, decision-makers are prone to make decisions that lean towards that suggested value.

Past literature has highlighted that the anchoring effect can introduce individual-level biases in various decision-making situations—the direction of this bias is always towards the initial hint or suggestion (anchor). In the presence of a cue or an anchor, people respond to factual questions and common general knowledge in a manner such that their answers are skewed toward the initial cue (Wegener et al., 2001; Epley & Gilovich; 2001; Epley & Gilovich, 2005; McElroy & Dowd, 2007). Similar biases towards the anchor are seen in individuals while providing probability estimates (Plous, 1989; Chapman & Johnson, 1999), providing valuations or making purchasing decisions (Ariely et al., 2003), forecasting (Critcher & Gilovich, 2008), and negotiating (Galinsky & Mussweiler, 2001). The anchoring effect can also influence individuals reviewing legal judgments (Hastie et al., 1999; Marti & Wissler, 2000; Englich & Mussweiler, 2001; Englich et al., 2005, 2006; Englich & Soder, 2009) or providing business timelines (Lorko et al., 2019). In the retail context, in the presence of a suggested price, consumers' willingness to pay or willingness to accept a specific price for a product was found to be biased towards the suggested price (Green et al., 1998; Ariely et al., 2003; Simonson & Drolet, 2004).

The anchoring effect has been extensively used in several behavioral studies in marketing, which investigated the impact of "purchase quantity limits" on new/exclusive or discounted products (Wansink et al., 1998; Howard et al., 2007; Chernev, 2008; Ku, 2019). According to these studies, a consumer goes to the retail store with a "default anchor," the planned number of purchase units or the number of units they usually purchase of a product (Wansink et al., 1998). However, when encountering the purchase quantity limits, consumers expand their anchors and buy more than they need. As such, in the presence of these limits, consumers make decisions based on comparative values and change their perceived demand based on the observed purchase quantity limits (Wansink et al., 1998; Furnham & Boo, 2011).

Another stream of literature has found that individual factors can also affect the anchoring effect. People are less susceptible to the anchoring effect in a neutral or happy mood than their sad mood counterparts (Bodenhausen et al., 2000; Englich & Soder, 2009). Similarly, researchers have highlighted that knowledge, experience, and expertise make people less influenced by the anchors presented (Wilson et al., 1996). Comparably, individuals having higher cognitive ability were also less affected by the anchoring effect (Bergman & Gilovich, 2010). Furthermore, reduced anchoring effects were seen when the respondents were warned about the possible anchoring effect in a specific study (LeBoeuf & Shafir, 2009). Investigators have also found that personality also affects the anchoring effect. Participants who are high in conscientiousness and agreeableness and low in extraversion are more vulnerable to the anchoring effects (Eroglu & Croxton, 2010). Furthermore, individuals with higher openness to experience are more influenced by the anchoring effect (McElroy & Dowd, 2007).

Social Nudges

The concept of social nudges was introduced in the behavioral science literature by Thaler and Sunstein (2008). They argued that individuals could be nudged or moved to make wiser choices by subtly modifying their decision-making environment. These nudges can be through modifying the language in which the decision is introduced or the language of the provided options. These nudges can gently guide an individual to a more acceptable social behavior without mandating or forbidding his options. It was introduced to the literature by successfully implementing the much-acclaimed "Don't Mess With Texas" anti-littering campaign on Texas's highways initiated by the Texas department of transportation, which reduced littering by 72% (Thaler & Sunstein, 2009). Nudges have also been used in other social contexts, such as choosing healthy dietary habits (Colby et al., 2020), managing a healthy weight (Valle et al., 2020), making responsible investments (Pilaj, 2017), and a variety of other behavioral modifications in individuals (Duckworth et al., 2020).

Nagatsu (2015) described two mechanisms explaining how social nudges influence individuals' behavior. First, nudges act as a means of social norm engineering (Nagatsu, 2015). Individuals are equipped with psychological mechanisms that shape their normative behavior from empirical expectations in certain social contexts. For example, if you tell a college student that alcohol abuse is less prevalent than he thinks, he is less likely to binge drink (Thaler & Sunstein, 2009). Thus, using social nudges, individuals who are more willing to conform to prescriptive nudges change their behavior, which in turn leads those with weaker conformist preferences to change until, eventually, most people alter their behavior. The second mechanism defines social nudges as framing (Thaler & Sunstein, 2009). Social nudges may stimulate people to shift from an "I" frame to a "we" frame when faced with social dilemmas by increasing pro-social, group-oriented behavior. This shift, however, should be supported by the individual's practical reasoning.

Hypothesis Development

Anchoring effect and stockpiling propensity

The premise of our model is the presence of an impending natural disaster. We specifically look at the scenario where the purchase quantity limits are higher than the consumer needs as we recognize that when the limits are lower, consumers always buy at the limit. Under such circumstances, we study the effect of retailers' purchase quantity limits on consumer behavior. Impending disasters raise doubts about the future availability of essential products. When the future availability of a product is uncertain, consumers must decide whether to purchase it now or risk missing out on the purchase opportunity and face stock out later (Pan et al., 2020). Even though consumers may regret their decisions regardless of whether they act (e.g., to buy now) or not (e.g., to not buy now), there is a greater sense of regret for inaction than for action (Gabler et al., 2017). Thus, to prevent regret for not buying the right amount of product for future use when the product was available, consumers' perceived scarcity increases, making the product more desirable (Gabler et al., 2017; Shi et al., 2020). Increased product desirability increases consumers' stockpile intention, thus increasing their stockpiling propensity (Billore & Anisimova,2021).

When the consumers find that the retailer's purchase quantity limits are higher than their needs, anchoring effect kicks in. Due to anchoring effect, consumers' planned purchases get biased towards the suggested anchor, i.e., the retailer's purchase quantity limit. This causes the consumer adjusts their initial planned purchase and increase it to be near the limit, as they believe this is the amount everyone else is buying (Wansink et al., 1998; Howard et al., 2007; Chernev, 2008; Ku, 2019). As the purchase quantity limits increase, the anchor expands, and the consumers' planned purchase follows the anchor and thus increases. Increased consumers purchase beyond their average needs following the anchor, increasing the stockpiling propensity. Thus we lay down our first hypothesis.

H1: In the presence of an impending natural disaster, when consumers' needs are less than the retailer's set purchase limit, a retailer's set purchase limit has a positive direct effect on the consumers' stockpiling propensity.

Impact of perceived future regret of not purchasing

When the retailers' purchase limits are set low (but higher than the needs), they reinforce consumers' perception that the product is in short supply and the future availability of the product is questionable. Consumers consider the uncertain future of the product's supply, which leads consumers to think about buying the product then or regret it later due to fear of future unavailability or stockouts, thus increasing the perceived future regret of the consumers (Loomes & Sugden, 1982; Zeelenberg et al., 2002). As the purchase quantity limits increase, consumers' perception that the product is in short supply decreases as they associate the higher purchase limits with increased product availability. This perception of future product availability reduces consumers' uncertainty over the future availability of the product. As the uncertainty around the product's supply decreases, consumers' sense of regret for not purchasing the product then, thus reducing the perceived future regret of the consumers and hence reducing the consumers' perceived scarcity (Gabler et al., 2017; Shi et al., 2020). As the consumers' perceived scarcity decreases, consumers' desirability and attractiveness for the product also decrease (Szybillo, 1975; Lynn, 1991; Vigneron & Johnson, 1999). So consumers become less likely to stockpile the product. Thus, in conclusion, retailers increasing consumers' purchase quantity limits can reduce consumers' perceived future regret by reducing their perceived uncertainty which can reduce the perceived scarcity of the consumers leading them to stockpile less.

H2a: In the presence of an impending natural disaster, as a retailer increases a purchase quantity limit for a product, consumers' perceived future regret of not purchasing the product decreases.

H2b: In the presence of an impending natural disaster, when consumers' needs are less than the retailer's set purchase limit, consumers' perceived future regret positively affects consumers' stockpiling propensity.

H2c: In the presence of an impending natural disaster, when consumers' needs are less than the retailer's set purchase limit, a retailer's set purchase limit has a negative indirect effect on the consumers' stockpiling propensity and consumers' perceived future regret mediates this relationship.

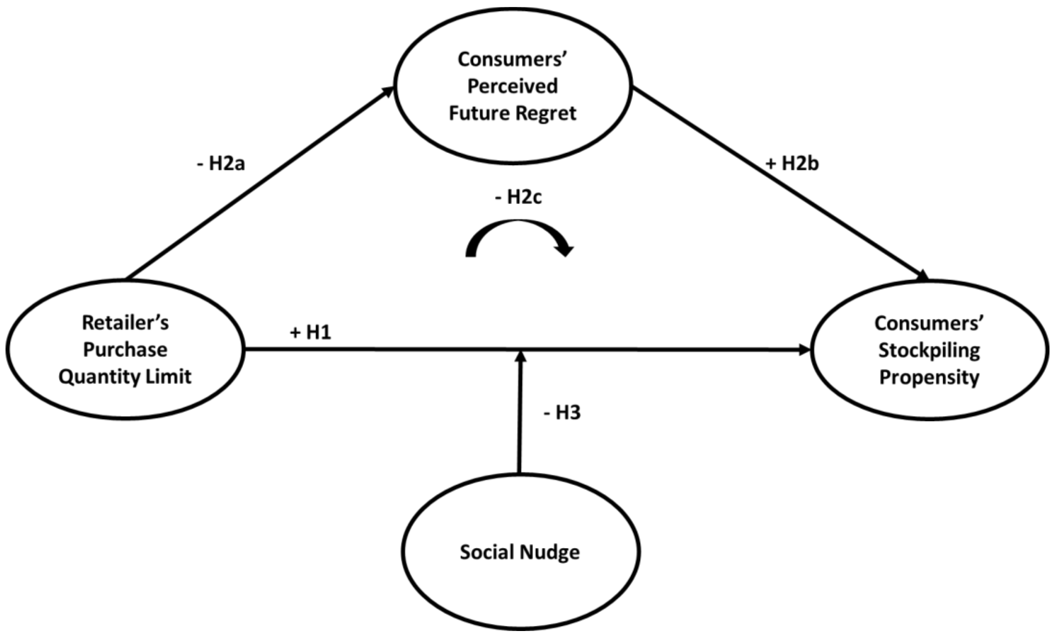
Impact of Social Norm Disclosures

When the purchase limit is more than consumers' needs, the anchoring effect can lead consumers to buy more than they need. However, retailers sometimes put up messages in the product aisles highlighting social norms or acceptable social behavior that can remind consumers about proper and good behaviors during a disaster. When consumers see these messages, even with the anchoring effect, the messages can act as an intervention and nudge the consumer to conform to the socially acceptable behavior. The nudge influences consumers to shift from an "I" frame to a "we" frame while shopping, thus considering not only their own needs but also the needs of the people in the community they live in (Nagatsu, 2015). While considering the community needs, consumers change their behavior to a socially acceptable one (Braton, 2015), leading consumers to buy what they actually need and avoid stockpiling. Thus, with the presence of social nudge messages, we posit that consumers' stockpiling propensity decreases.

H3: In the presence of an impending natural disaster, when consumers' needs are less than the retailer's set purchase limit, social nudge messages negatively moderate the positive relationship between a retailer's set "purchase limit" and consumers' stockpiling propensity.

The empirical model with the path hypothesized is provided in Figure 1.

Figure 1: Conceptual Model



Methodology: Overview

Experimental development

To test our five hypotheses, we employed a scenario-based experimental design. We used a three-step process: pre-design, design, and post-design stages for creating our vignettes (Rungtusanatham et al., 2011). In the pre-design stage, information was gathered about the context of our research question to base our design on a factual scenario (how retailers employ product rationing during disasters). To ensure our research context was grounded in reality, we reviewed the nature and types of purchase quantity limits and social nudge messaging used by various retailers referring to old pictures and articles over the internet (please refer to appendix). The purchase quantity limits widely vary based on the size of the product, the number of products in a pack and retailer type. Furthermore, based on the available supply and demand of the product, retailers employ low limits such as one or two products per shopper or family or higher limits such as 3,4 or even 5. Big box retailers can employ even higher purchase quantity limits, such as seven or more. We also looked at the supply chain management literature to find the products most sorted out by consumers during natural disasters. FEMA puts drinking water, non-perishable food, and batteries as the top three critical products that one should have before the disaster strikes. Using the top product from FEMA's list, supply chain researchers have used bottled water to study consumer stockpiling propensity during disasters (Pan et al., 2020).

Next, in the design stage, we developed our common module (part of the hypothetical scenario that was held constant across all the treatment groups) (Rungtusanatham et al., 2011). We created a hypothetical scenario where consumers were informed that a category two hurricane was expected to make landfall in their area. The participants were informed of their weekly need of 2 cases of bottled water. We then proceeded with the experimental module (part of the hypothetical scenario that varied across treatment groups) (Rungtusanatham et al., 2011). Various treatments were created where both the purchase quantity limits and the presence or absence of social nudge messaging were manipulated. We manipulated the purchase quantity limit to be 3, 5, and 7 (please refer to appendix).

In the post-design stage (Rungtusanatham et al., 2011), we presented the final scenarios to a panel of two experts for feedback concerning clarity and realism. Based on their feedback, we made some minor adjustments. Next, we conducted a pretest to assess the validity of our manipulations. We specifically wanted to test that the presence of a natural disaster indeed increased perceived future regret and thus perceived scarcity, as this was one of the assumptions of our study. We also wanted to check if the amount of product left on the retail shelf affects consumer purchase behavior. We employed a 2 (Disaster present/absent) X 2 (Retail shelves half-filled/fully-filled with bottled water) design for our pretest. The Amazon Cloud Research platform (Litman & Abberbock, 2017) was used to collect responses from 94 adults from the US who were randomly assigned to only one of the four treatment conditions. The mean age of the respondents was 40 years, and 37% of respondents were female. The respondents' median gross income was $30,001–$50,000, and the median education level was a four-year college degree. A one-way ANOVA found no significant difference in perceived future regret and stockpiling propensity between the half-filled and fully filled shelves treatments (Table 2), providing evidence that the amount of product left on retail shelf product is not a potential confound. The presence of a disaster significantly increased perceived future regret and stockpiling propensity adding validity to our initial assumptions. In addition, participants were asked to evaluate the following statement "The shopping situation described was realistic." Participants evaluated the shopping scenario as highly realistic, with a mean score of 6.5 on a 7-point Likert scale for realism (Rungtusanatham et al., 2011; Peinkofer et al., 2016; Peinkofer et al., 2021).

TABLE 2: Pretest Analysis (Comparison between the Disaster and No Disaster Condition)

		Stockpiling Propensity	**Perceived Future Regret**
Disaster Absent	Mean	0.60	-0.31
	N	45	45
	σ*	1.01	0.85
Disaster Present	Mean	2.41	0.31
	N	49	49
	σ*	0.98	0.92

σ*: Std deviation

Manipulations, manipulation checks, and sample

The main experiment constituted a 4 (none, 3, 5, or 7 Limit) x 2 (Social nudge present/absent) between-subjects design. Using the cloud research platform (Litman & Abberbock, 2017), we recruited a total of 468 adults from the US to participate. To increase the quality of the responses, we employed a filter to choose participants who had completed at least

1,000 tasks before participating in our study and had at least a 90% approval rate. All participants were randomly assigned to only one of our six experimental conditions, and each participant was compensated with $1.50. In line with Goodman et al. (2012), we included an attention check. We also checked for an unusually high number of intended purchase quantities and removed the participants who wanted more than 10 cases of water. Nineteen participants failed the attention check and were removed to increase data quality (Abbey & Meloy, 2017). Additionally, an instructional manipulation check was embedded to check whether the participants read the instructions correctly and remembered that they were told that their weekly need was 2 cases of bottled water (Oppenheimer et al., 2009). Seven participants failed this check and were also removed from the sample.

Two factual manipulation checks were used to test the validity of our experimental manipulations (purchase limit of none 3,5, or 7 and presence or absence of social nudges) (Perdue & Summers, 1986; Bachrach & Bendoly, 2011). A factual manipulation check collects objective responses to factual questions about information included under each treatment (Kane & Barabas, 2018). The first factual manipulation check validated whether the respondents remembered the exact purchase quantity limit or the presence or absence of social nudges. (details of the treatment examples appear in the Appendix). Forty-two participants failed the manipulation checks and were removed from the data to ensure high data quality (Abbey & Meloy, 2017).

The final sample consisted of 400 responses, with 43% reporting themselves as female. The age of the participants varied between 19 and 78 years, with a mean age of 40 years. The median income was in the range of $30,001 to $50,000, and the median education level was a four-year college education. In line with our pretest, participants perceived the scenarios as highly realistic, with a median response of 6.2 on a 7-point Likert scale, supporting the scenario's realism (Eckerd et al., 2013). The distribution for the number of participants per treatment is provided in Table 3.

TABLE 3: Participant Distribution Across Treatment

Limit	Social Nudge	Number of Participants
None	Absent	44
	Present	54
3	Absent	45
	Present	48
5	Absent	55
	Present	56
7	Absent	48
	Present	50

Measures

Our scaled dependent variables of interest — perceived future regret was adapted from Connolly & Reb (2011) and was measured with a four-item, 7-point Likert scale. All scale items are provided in Table 4. Similar to the pretest, consumers' stockpiling propensity was measured as consumers' stockpiled quantity, and it was calculated by subtracting the consumer needs (i.e., 2) from the quantity consumer wanted to purchase. Additionally, controls were added for age, gender, income, race, education, and past experience with natural disasters (Pan et al., 2020), living in areas prone to natural disasters, and living in areas prone to high-intensity natural disasters (Pan et al., 2020) (please refer to appendix). All the controls had a single-item scale.

Confirmatory factor analysis

Convergent validity assessments of the variables of interest were carried out through confirmatory factor analysis using MPLUS 8. A one-factor model was estimated, including perceived future regret (Wieland et al., 2017).

The fit statistics of our refined model support our measurement model (Kline, 2005) with $\chi2 = 1.80$, df = 1, p-value=0.18 comparative fit index (CFI) = .99, root mean square error of approximation (RMSEA) = 0.045 (90% confidence interval: 0.00 ; 0.149), and standardized root mean square residual (SRMR) = .004. The average variance extracted (AVE) was calculated to establish convergent validity, and Cronbach's α was calculated for reliability analysis. The AVE for our factor of interest exceeded the recommended threshold of .5 (Fornell & Larcker, 1981), and the α values exceeded .8 (Nunally & Bernstein, 1994). Table 4 summarizes the standardized loadings and AVE and α values, and Table 5 shows the correlation matrix of our variables of interest. Upon confirmation of the measurement model, following best practices, the mean-centered factor scores were extracted using the CFA model and the Bayes estimator (Calantone et al., 2017).

TABLE 4: Confirmatory Factor Analysis

Variables	Adapted from	Items*		Loading	AVE and α**
Perceived future regret	Connolly and Reb (2011)	RE1	In the future, would you feel sorry for not purchasing more cases of bottled water?	0.81	AVE = 0.77 α = 0.94
		RE2	In the future, would you regret not purchasing more cases of bottled water?	0.87	
		RE3	Should you have purchased more cases of bottled water?	0.89	
		RE4	Do you anticipate feelings of regret for not purchasing more cases of bottled water?	0.93	

$\chi2$(df)=1.80 (1) p-value=0.18; CFI=0.99; RMSEA=0.045 [0.00 - 0.149]; SRMR=0.004

**α: Cronbach's alpha

TABLE 5: Correlation Matrix (n = 400)

	1	**2**
Perceived Future Regret	1	
Stockpiling Propensity	.12*	1

Note: **p* < 0.01; ***p* < 0.05.

Validation Checks

We performed Hawthorne check to determine whether the treatments had changed participants' goals or motivations, which could subsequently affect observed differences between groups (Adair, 1984). To provide assurance in this regard, we followed Tokar et al. (2014) and Ta et al.(2018) and conducted the test via three items adapted from Bendoly and Swink (2007). Assessing the extent to which respondents rated three goals as important to the research scenario provided insight into whether there was any difference in the subjects' goals across treatments. On a 7-point scale, where 1=Not at all important and 7=Extremely important, subjects evaluated the following goals: (1) Ensuring purchasing products on my weekly list. (2) Ensuring purchasing products at a low price, and (3) Ensuring purchasing products of good quality. The results (F= 1.82, p=0.14; F=.22, p=0.88; F=0.76, p=0.52) indicated that no significant differences between conditions existed on any of these issues, showing Hawthorne effects not to be a concern.

A common method variance (CMV) is the spurious correlation produced by using the same method to measure each variable, leading to false conclusions about relationships between variables (Podsakoff et al., 2012). We mitigate the risk of common method bias by using the CFA marker variable procedure proposed by Williams et al. (2010). We adopted the blue attitude items and added them to our list of questions. (Miller & Chiodo, 2008). The scale items were added to the CFA model and checked whether it increased the model fit. The CFA model with the blue scale items had a significant χ2 showing a worse model fit (χ2(df)=22.49 (12), p-value=0.03; CFI=0.99; RMSEA=0.047 [0.013 - 0.076]; SRMR=0.029), indicating that CMV was not a concern (Williams et al., 2010). Thus the blue attitude items were excluded from the main model.

Analysis and results

The premise of our hypothesis is there is an impending natural disaster, and the retailer has set a purchase quantity limit higher than the need of the consumers. One of the assumptions of the premise is that there is a significant difference in consumer stockpiling propensity between the retailer setting the limits and not placing the limits. Thus before testing our hypotheses, we establish the validity of our premise. For this purpose, we analyze the means when the limit is absent and when the limit is present (3,5 or 7). The ANOVA analysis reveals a significant difference between the two groups (Limit Absent/Present = 1.28/1.69, $p < 0.05$)

After establishing our context, we move towards testing our hypotheses. To test H1–H2, we used PROCESS Model 4 (Hayes & Preacher, 2013), which tests a simple mediation model. We selected PROCESS as it offers both moderation and mediation analysis through a single tool using OLS regression in the background. The independent variable in the model was a categorical variable that represented the levels of purchase quantity limits set by the retailer (3,5,7). Indicator coding was used for our independent variable. Limit 3 is used as the control group as we hypothesize the relationship at various levels of purchase quantity limits. Our treatment has three possible values: X1 compares limit-3 and limit-5, and X2 compares limit-3 and limit-7. This analysis aimed to validate the effect of various levels of limits on our DVs consumers' perceived future regret and consumers' stockpiled quantity. As hypothesized, we test for a simple mediation model (Purchase quantity limits → perceived future regret→consumers' stockpiling propensity). Our treatment groups are sized unevenly, but equal treatment groups is not an assumption of OLS regression; additionally, we use bootstrap confidence intervals based on 5,000 resamples, which remedies sampling distribution that is not normal (Hayes, 2012). Process Model 4 mediation effect analysis results are provided in Table 6 and Table 7: While Table 6 provides the regression results with perceived future regret and stockpiling propensity as the dependent variable, Table 7 estimates the direct and indirect effects as hypothesized.

TABLE 6: Regression Results from PROCESS Model 4 Analysis

PROCESS Model 4 N=302; DV=	**Perceived Future Regret**		**Stockpiling Propensity**	
Adj R-sq	0.06		0.33	
F-value	1.95		12.75	
p-value	0.04		0.00	
Antecedents	**Coeff**	**Se**	**Coeff**	**Se**
X1a (β_1)	-0.33*	0.14	1.18**	0.19
X2b (β_2)	-0.45**	0.14	2.14**	0.19
Perceived future regret (β3)			0.33**	0.08
Income	0.03	0.04	-0.05	0.05
Gender	-0.05	0.1	0.13	0.14
Education	-0.04	0.05	0.14*	0.06
Race	-0.04	0.06	-0.15	0.08
Age	-0.01	0.01	0.01	0.01
Control1	-0.01	0.04	0.01	0.06
Control2	0.17*	0.08	0.05	0.11
Control3	-0.12	0.08	-0.09	0.11
Constant(β_0)	0.59	0.38	0.38	0.51

Note: *$p < 0.01$; **$p < 0.05$.

[a]X1: Compares Limit-3 to Limit 5

[b]X2: Compares Limit-3 to Limit 7

Control1: Past experience with natural disasters.

Control2: Live in an area that is close to possible natural disasters.

Control3: Live in an area that is close to possible high-intensity natural disasters.

TABLE 7: Direct and Indirect Effects from PROCESS Model 4 Analysis

Model 4: Relative direct effects of X on Y (TR[c] --> Stockpiled Units)						
	Effect	**Se**	**T**	**P**	**LLCI**	**ULCI**
X1[a]	1.18	0.19	6.35	0.00	0.81	1.54
X2[b]	2.14	0.19	11.2	0.00	1.76	2.52
Model 4: Relative indirect effects of X on Y (TR--> Perceived regret --> Stockpiled Units)						
	Effect	**BootSE**	**BootLLCI**	**BootULCI**		
X1	-0.11	0.06	-0.23	-0.02		
X2	-0.15	0.06	-0.28	-0.05		

[a]X1: Compares Limit-3 to Limit 5

[b]X2: Compares Limit-3 to Limit 7

[c]TR: Treatment X1 and X2

From Table 7 (Relative direct effects of X on Y), we found that purchase quantity limits (X1, X2) have a direct effect on consumers' stockpiling propensity (β_1= 1.18, $p < 0.01$; β_2 =2.14, $p < 0.01$), supporting H1. H2a is hypothesized as a negative effect of purchase quantity limits (X1, X2) on consumer's perceived future regret and H2b is hypothesized as a positive relationship between consumer's perceived future regret and consumers' stockpiling propensity. From Table 6, Model 4 we find support for both H2a ($\beta_{1=}$-0.33, $p < 0.05$; β_2 = -0.45, $p < 0.01$) and H2b (β_3 = 0.33, $p < 0.01$). H2c hypothesizes the negative indirect effect of purchase quantity limits (X1, X2) on consumers' stockpiling propensity, mediated through consumer's perceived future regret (purchase quantity limits→ perceived future regret → stockpiling propensity). Refering back to Table 7 (Relative indirect effects of X on Y), we also find support for H2c (Effect X1= -0.11, *LLCI= 0.81 ULCI= 1.54*; Effect X2= -0.15, *LLCI= 1.76 ULCI= 2.52*).

To test H3, a mediated moderation model, we used PROCESS Model 5 (Hayes & Preacher, 2013), which tests a mediation with direct effect moderation. We built on the previous model 4 analysis and used a similar independent variable in the model, a categorical variable that represented the levels of purchase quantity limits set by the retailer (3,5, and 7). H3 aims to validate the moderation effect of social nudges in the presence of purchase quantity limits on our DV consumers' stockpiling propensity. Thus the moderator in this model is the presence or absence of the social nudge, with social nudge being a dummy variable (0-absent, 1-present). Similar to the previous model, controls were added for age, gender, income, race, education, and past experience with natural disasters (Pan et al., 2020), living in areas prone to natural disasters, and living in areas prone to high-intensity natural disasters (Pan et al., 2020). The results from this analysis are shown in Table 8 and Table 9: Table 8 provided regression results with perceived future regret and stockpiling propensity as the dependent variable, whereas Table 9 analyzed the direct and indirect effects.

TABLE 8: Regression Results from PROCESS Model 5 Analysis

PROCESS Model 5 N=302; DV=	Perceived Future Regret		Stockpiling Propensity	
Adj R-sq	0.06		0.34	
F-value	1.95		10.63	
p-value	0.04		0.00	
Antecedents	**Coeff**	**Se**	**Coeff**	**Se**
X1a (β1)	-0.33*	0.14	1.19**	0.26
X2b (β2)	-0.45**	0.14	2.42**	0.27
Perceived future regret (β3)			0.33**	0.08
Social Nudge(β4)			-0.11	0.27
Int_1			-0.01	0.36
Int_2			-0.55	0.37
Income	0.03	0.04	-0.06	0.05
Gender	-0.05	0.1	0.15	0.14
Education	-0.04	0.05	0.15*	0.06
Race	-0.04	0.06	-0.15	0.08
Age	-0.01	0.01	0.01	0.01
Control1	-0.01	0.04	0.03	0.06
Control2	0.17*	0.08	0.03	0.11
Control3	-0.12	0.08	-0.08	0.11
Constant(β0)	0.59	0.38	0.39	0.52

Note: $*p < 0.01$; $**p < 0.05$.

[a]X1: Compares Limit-3 to Limit 5

[b]X2: Compares Limit-3 to Limit 7

Control1: Past experience with natural disasters.

Control2: Live in an area that is close to possible natural disasters.

Control3: Live in an area that is close to possible high-intensity natural disasters.

TABLE 9: Direct and Indirect Effects from PROCESS Model 5 Analysis

Model 5: Relative direct effects of X on Y (TR* → Stockpiled Units)						
	Effect	**Se**	**T**	**P**	**LLCI**	**ULCI**
X1[a]	1.18	0.19	6.35	0.00	0.81	1.54
X2[b]	2.14	0.19	11.2	0.00	1.76	2.52

Model 5: Relative indirect effects of X on Y (TR→ Perceived regret → Stockpiled Units)				
	Effect	**BootSE**	**BootLLCI**	**BootULCI**
X1	-0.11	0.06	-0.23	-0.01
X2	-0.15	0.06	-0.29	-0.05

[a]X1: Compares Limit-3 to Limit 5

[b]X2: Compares Limit-3 to Limit 7

[c]TR: Treatment X1 and X2

H3 looks at the effect of social nudges on the relationship between retailers' purchase quantity limits and consumers' stockpiling propensity. From Table 8, we didn't find support for the moderation effect of social nudge messages on the relationship between individual purchase quantity limits (X1, X2) and consumers' stockpiling propensity (Γ_1= 0.01, *p>0.05*; Γ_2= -0.55, *p>0.05*). Thus, H3 is not supported.

Discussion

We answer our three research questions through experimental design, 400 valid responses, and multiple manipulation checks. Our research questions are based on the premise that there is an impending disaster and the purchase quantity limit is higher than the consumer needs. So we test the validity of the assumptions around this premise. Our pretest supports that impending disasters increase perceived scarcity due to increased future regret. We also found that the presence of purchase quantity limits, on average, increases the stockpiling propensity of the consumer.

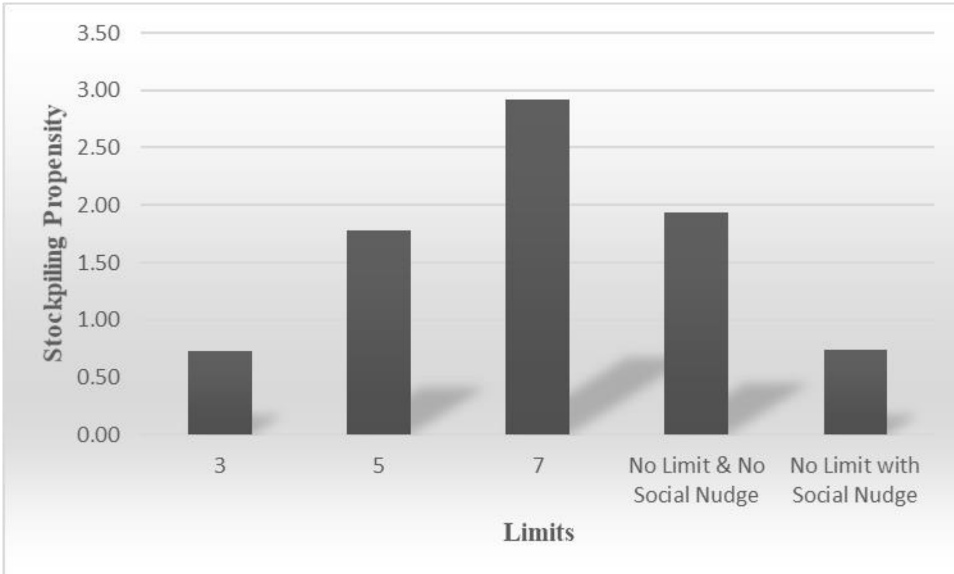
After setting up the premise, we move on to answer our first research question, i.e., how do purchase quantity limits employed by a retailer during disasters impact consumers' stockpiling behavior? The answer to this question is that purchase quantity has both a positive and a negative relationship with consumer stockpiling propensity. Our analysis indicates that in the presence of an impending natural disaster, when consumers' needs are less than the retailer's set purchase limit, purchase quantity limits have a direct (+ve) effect on consumer stockpiling propensity, in line with our theoretical predictions from anchoring effect. However, we also see an indirect (-ve) relationship between the retailer's set purchase limit and consumer stockpiling behavior under the premise of an impending natural disaster and consumers' needs being less than the purchase quantity limits. And this relationship is mediated by the perceived future regret (perceived scarcity) of the consumer. This answers our second research question (Does consumers' perceived scarcity play a role in this relationship between the retailer's purchase quantity limits and consumers' stockpiling behavior?). However, the magnitude of this indirect negative effect is notably much weaker than the strong positive direct effect due to the anchoring effect.

The answer to our research question three (i.e., how do signs from the retailer advocating social norms or socially acceptable behavior affect consumer stockpiling?) is though social nudges don't affect stockpiling propensity in the presence of purchase quantity limits, they reduce stockpiling propensity when no limits are placed. Our main analysis did not find any significant effect of social nudges in the presence of a purchase quantity limit. This might be attributed to the strong anchoring effect introduced due to the purchase quantity limits. This assumption can be supported by additional mean analysis, which reveals that even though social nudges have no significant impact in the presence of purchase quantity limits, they do significantly reduce stockpiling propensity when no limits are placed (refer to Table 10). The comparison of stockpiling propensity means (refer to Figure 2) suggests that the stockpiling propensity was the lowest when the limit was just above the needs (i.e., limit-3). There was no significant difference between consumers' stockpiling propensity under limit-3 or when social nudge messages were displayed without placing any purchase quantity limits. This suggests that the stockpiling propensity was either similar (limit-3) or significantly less(limit-5 or 7) when the retailer displayed a social nudge message without placing any purchase quantity limits compared to purchasing quantity limits.

Table 10: Stockpiling in the Presence of Limits and Social Nudges

Purchase Quantity Limits	Presence/ Absence of Social Nudge	N	Mean Stockpiling Propensity	Std. Deviation	Mean Square Difference	F
3	0	45	0.73	0.45	0.27	1.24
	1	48	0.63	0.49		
5	0	55	1.78	1.18	0.68	0.38
	1	56	1.63	1.50		
7	0	48	2.92	1.61	8.14	2.56
	1	50	2.34	1.93		
None	0	44	1.93	1.59	34.40**	15.94
	1	54	0.74	1.36		

Figure 2: Stockpiling Propensity Under the Various Limit Conditions



Research Implications and Contributions

Theoretical Contribution

Our study offers a significant contribution to three major streams of literature. First, our research contributes to the micro-level disaster management literature (Pan, 2020; Gupta et al., 2016) specifically considering the retailer action and consumer behavior literature during natural disasters. Past literature in this space has established that consumers' attributes (such as disaster experience and household income) and retailers' attributes (retail network and product assortment carried) can affect stockpiling propensity of the consumer (Pan et al., 2020). Our study extends the existing literature by adding purchase quantity limits and messages highlighting acceptable social norms as a guard against consumer stockpiling behavior. Our study provides a nuanced understanding encompassing the two mechanisms working simultaneously, when consumers encounter purchase quantity limits: perceived scarcity and anchoring effect. We not only provide support for existing literature that had considered that natural disasters increase perceived scarcity due to increased consumer uncertainty, thus inducing consumer stockpiling (Devasagayam, 2017; Pan et al., 2020; Billore & Anisimova, 2021), but also build on this premise by empirically testing a theoretical model which studies the effect of retailers' purchase quantity limits on consumer behavior. As of our knowledge, our study is the only study that looks at the effect of purchase quantity limits on consumer behavior during natural disasters, and we establish two mechanisms, i.e., perceived scarcity (perceived future regret) and the anchoring effect, which guide consumer behavior. Our study highlights the stronger (+) direct effect (due to the anchoring effect) and the weaker (-) indirect effect (perceived scarcity) purchase quantity limits have on consumer stockpiling.

Second, our study brings anchoring effects to the disaster setting and analyses how it operates alongside perceived scarcity. Similar to anchoring effect literature from a non-disaster setting (Wansink et al., 1998; Howard et al., 2007; Chernev, 2008; Ku, 2019), we also found a strong direct (+) effect of purchase quantity limits on consumer stockpiling. Additionally, we established a (-) indirect effect (due to perceived scarcity) of purchase quantity limits on consumer stockpiling due to the disaster setting.

Third, our study brings social nudges to the disaster setting in a retail environment. Unlike the positive effect of social nudges seen in an individual context, such as choosing healthy dietary habits (Colby et al., 2020), managing a healthy weight (Valle et al., 2020), and making responsible investments (Pilaj, 2017), there no significant effect of social nudges on consumers in the presence of retailer's purchase quantity limits. This may be attributed to the strong effect of the anchoring effect resulting from such limits. When no limits were placed, social nudges significantly reduced consumer stockpiling propensity. These findings can substantiate the assumption that in the presence of the anchoring effect, social norms may not provide the desired results.

Managerial Contributions

Our study provides considerable recommendations for retail executives and store managers while preparing their stores during impending disasters. When the supply of an essential product is low during natural disasters, retailers have no choice but set the purchase quantity limits low. Nevertheless, this may not fully fulfill consumer needs and may not ensure an equitable distribution.

Most modern retailers have access to big data and can keep track of their consumer needs. Retailers carry information about the consumers a particular store serves and the average needs of the consumers for that store. When such retailers have sufficient supplies before a disaster but want to prevent stockpiling in order to maintain product availability, our results suggest that setting the purchase limits just above the consumer needs helps minimize overall stockpiling while fulfilling the needs of the consumers. However, sometimes retailers or store managers may have limited time to respond to disasters or may not have the information about the consumers a particular store serves. In such a scenario, even though such retailers may have sufficient supplies, they might want to prevent stockpiling to maintain product availability. Under such a scenario, our study suggests that using social nudge messaging rather than setting a purchase quantity limit can be the best approach to fulfill maximum needs while minimizing stockpiling. Our findings show that the stockpiling propensity was either similar or significantly less when the retailer displayed a social nudge message without placing any purchase quantity limits compared to purchasing quantity limits.

Limitations and Directions for Future Research

It is important to interpret the current research within its limitations. First, this research has been conducted within the context of retailers' quantity limits in hypothetical disaster settings, and thus, the findings may not be generalizable to other retailer strategies in disaster or non-disaster settings. Furthermore, our study assumes that the purchase quantity limit is higher than the consumer need; thus, the findings may not be replicated when the limits are less than the needs. We leave it onto future researchers to use modeling in order to model consumer response at various levels of need and retailer limits.

Second, we have considered the needs of consumers for a retail store to have a low standard deviation, i.e., the needs to be clustered around the mean. The finding may be difficult to replicate when the consumer needs at a store have a large variance. Future research may look into individual consumer responses to have a nuanced understanding of the overall consumer response at a store.

Third, we have not considered the influence of other consumers on consumer response. Extant literature suggests that inter-consumer interactions can influence consumer response at a retail store (Li et al.,2013). Future research may explore how consumer interactions affect consumer behavior and stockpiling during disasters.

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Appendix

Participant Instructions

Thank you for your participation in this survey!

This is a 2-part survey.

In the first part, you will be presented with a scenario. You will be asked several questions related to the scenario.

In the second part, you will answer several additional questions related to your personal background.

For some questions, you CANNOT move forward until the preset time is over. Please take the time to read the questions carefully.

Please complete in ONE SITTING. Your answers are VERY IMPORTANT and VALUABLE to us!

Please take it seriously.

Disaster Scenario (Common Across All Treatments)

You are watching the news and they say that a Category 2 hurricane is expected to make landfall in your area in the next 48hrs with expected wind speeds of 96mph - 110mph. According to National Weather Service, extremely dangerous winds of the Category 2 hurricane will cause extensive damage such as:

Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.

Sample Treatments

No Limits and No Social Nudges

You decide to visit your local grocery store to shop for your weekly household needs. One of the items on your list is bottled water. Based on your experience, **you usually need 2 cases of bottled water** (a total of 24 bottles of 16.9 oz.) every week.

Limit-3

You decide to visit your local grocery store to shop for your weekly household needs. One of the items on your list is bottled water. Based on your experience, **you usually need 2 cases of bottled water** (a total of 24 bottles of 16.9 oz.) every week.

In the bottled water aisle (pictured below), you notice that the retailer has placed a **quantity limit of 3 cases per customer.**

Only Social Nudges

You decide to visit your local grocery store to shop for your weekly household needs. One of the items on your list is bottled water. Based on your experience, **you usually need 2 cases of bottled water** (a total of 24 bottles of 16.9 oz.) every week.

In the bottled water aisle (pictured below), you notice that the retailer has placed a sign that states, "**Think about your neighbors too. You help the community if you buy what you need"**.

Limit-5 and Social Nudges

You decide to visit your local grocery store to shop for your weekly household needs. One of the items on your list is bottled water. Based on your experience, **you usually need 2 cases of bottled water** (a total of 24 bottles of 16.9 oz.) every week.

In the bottled water aisle (pictured below), you notice that the retailer has placed a **quantity limit of 5 cases per customer**. Additionally, you see a sign that states, "**Think about your neighbors too. You help the community if you buy what you need"**.

Checks

Manipulation Check 1

Based on the shopping scenario you experienced, please identify the message you saw displayed over the shelf containing bottled water.

a) Limit- 3 case (12-bottles) per consumer
b) Limit- 5 case (12-bottles) per consumer
c) Limit- 7 case (12-bottles) per consumer

Manipulation Check 2

Based on the shopping scenario you experienced, did you also see the following message "Think about your neighbors too. You help the community if you buy what you need".

a) Yes
b) No

Hawthrone Check (Bendoly & Swink, 2007) - 7-point Likert scale

How important were the following in the shopping situation:

(Not at all important to extremely important)

c) Ensuring purchasing products on my weekly list.
d) Ensuring purchasing products at a low price.
e) Ensuring purchasing products of good quality.

Realism Check 1 - 7-point Likert scale

The shopping situation described was realistic.

(Strongly disagree to strongly agree)

Realism Check 2

What made the shopping situation seem realistic?

Marker Variable (Miller & Chiodo, 2008) - 7-point Likert scale

Thinking about YOUR OWN PERSONAL PREFERENCE, please indicate your level of agreement with the following statements:

(Strongly disagree to strongly agree)

a) I prefer blue to other colors.
b) I like the color blue.
c) I like blue clothes.

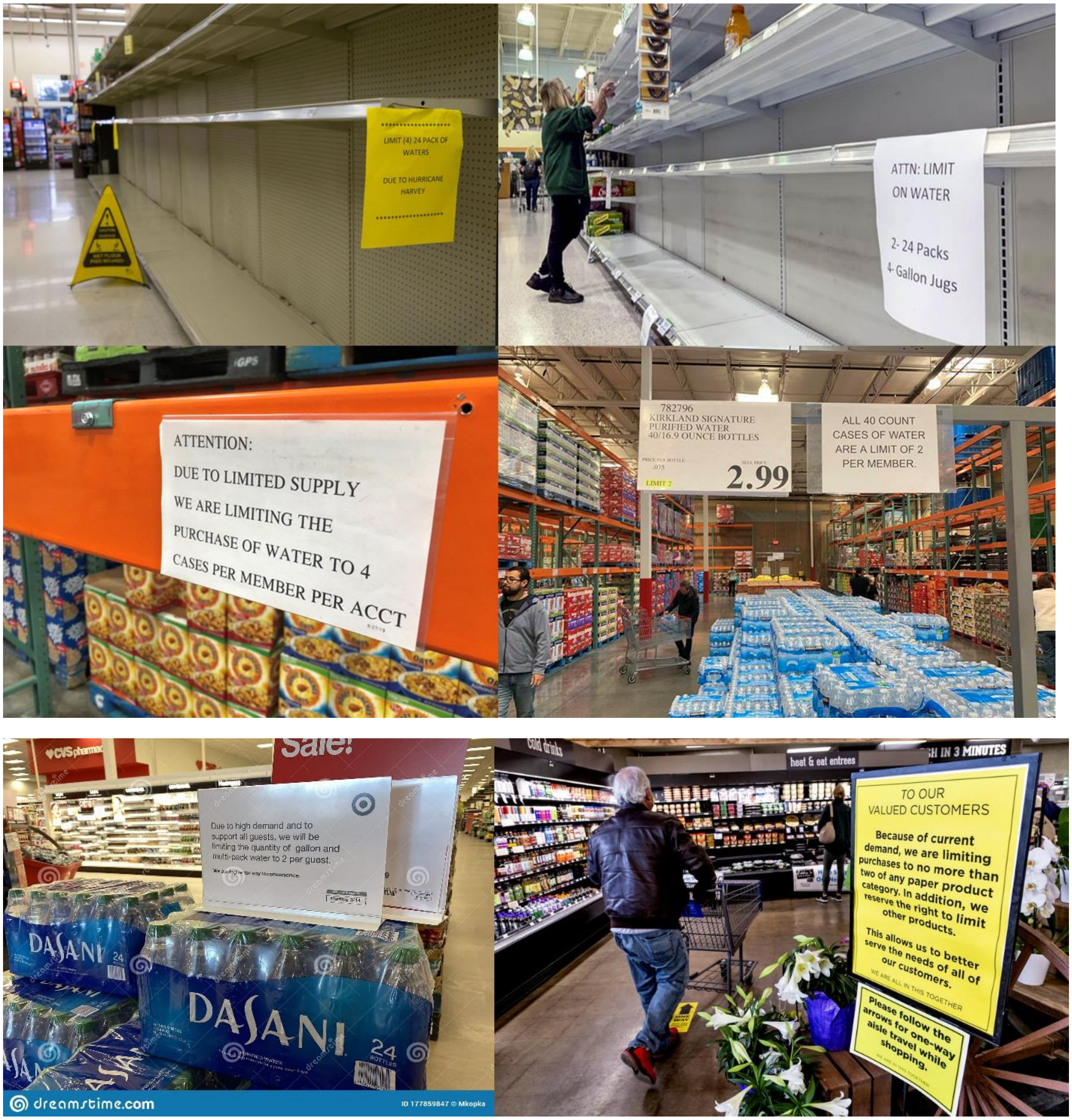
Controls - 7-point Likert scale

Thinking about YOUR RESIDENTIAL AREA, please indicate your level of agreement with the following statements:

(Strongly disagree to strongly agree)

a) I have past experience with natural disasters.
b) I live in an area that is close to possible natural disasters.
c) I live in an area that is close to possible high-intensity natural disasters.

Signs Employed by Various Retailers During Disaster



Essay 3: The Green Conundrum, "Slack" or "Not to Slack": Effect of Organizational Slack on Firm Green Supply Chain Management Performance.

Abstract

Traditional supply chain management literature has linked green supply chain management activities with waste reduction and increased efficiency. However, their adoption requires elements of change, innovation, and organizational flexibility, all of which require free resources above the firm's lean requirements or "slack." In this vein, using the tenets of the natural resource-based view (NRBV) and conceptualizing slack as providing the capabilities needed by a firm to reach its green supply chain goals, this study investigates how do different types of organizational slack impact a firm's green supply chain management performance (GSCM) and how a firm's operating environment's resource scarcity impact the prior discussed relationships. Specifically, two types of slack: financial and operational slack, were operationalized using publicly available data from Compustat and Sustainalytics databases. Results of a random effect model analysis indicate that the firm's absorbed slack and unborrowed slack (financial slacks), and capacity slack (operational slack) have a positive effect with diminishing returns on its GSCM performance. In contrast, inventory slack (a different kind of operational slack) has a negative effect with diminishing returns on a firm's GSCM performance. Moreover, we found that the firm's operating environment scarcity positively moderates the relationship between inventory slack and absorbed slack on GSCM performances GSCM performance.

Keywords: *Financial Slack; Operational Slack; NRBV; Green; Secondary Data Analysis*

Introduction

Recent years have seen an ever-increasing number of multinational corporations (MNCs) pledging to apply green supply chain management (GSCM) practices (Villena & Gioia, 2020). For example, according to World Economic Forum, around 8,550 organizations have now signed on United Nations' 2030 drive to promote sustained, inclusive, sustainable economic growth & industrialization (Neufeld, 2021). Driven by different motivations, these organizations are improving their environmental standards and adopting GSCM processes across their supply chains (Wong, 2021). Extant literature has linked GSCM practices with not only an increased firm's environmental performance (Ambec & Lanoie, 2008; Geng et al., 2017) but also with an increased firm's financial, stock market (Montabon et al., 2007; Ambec & Lanoie, 2008; Jacobs et al., 2010; Sarkis et al., 2010; Song et al., 2015) and operational performance (Liu & Zhao, 2008; Schmidt et al., 2017; Cousins et al., 2019). Ultimately, GSCM adoption has been found to be associated with an overall increase in a firm's triple bottom line, encompassing economic, social, and environmental performance (Hollos et al., 2012).

GSCM refers to the set of critical activities that ensures that a product manufactured by a firm does minimal harm to the environment throughout the product's lifecycle, i.e., starting from raw material procurement through manufacturing, sales, support, and finally, retirement (Carter & Carter, 1998; Min & Galle, 2001; Zsidisin & Siferd, 2001; Song, Yu, & Zang, 2015). GSCM encompasses internal firm-specific activities and dynamic boundary-spanning activities (Sarkis, 2012; Blome et al., 2013; Mishra et al., 2017) across the upstream supply chain (Awasthi et al., 2010; Chen & Ho, 2019). Firm-level activities include increasing the efficiency of raw material utilization and the efficiency of operational and logistics, as well as adopting green packaging, and reducing, reusing, and recycling waste (Zsidisin & Siferd, 2001; Song et al., 2015).

Boundary-spanning activities include investing in suppliers, improving communication and collaboration with suppliers on green performance issues, increasing supplier plant visits and audits, and recognizing suppliers' green performance through awards and incentives (Blome et al., 2013). Through all the activities, GSCM aims at resource waste reduction, resource reuse, resource recycling, and raw material substitution with other materials that have a lesser environmental impact across the firm's supply chain (Hoek, 1991; Carter & Carter, 1998; Carter & Elram, 1998; Min & Galle, 2001; Zsidisin & Siferd, 2001; Tseng et al., 2019). As the GSCM practices are new and continuously evolving, literature and our study synonymously use adoption, implementation, and performance with respect to GSCM (Zhu et al., 2008; Diabat & Govindan, 2011; Mitra & Datta, 2014; Mishra et al., 2017).

Academic literature has identified key external and firm-specific drivers of a firm's GSCM adoption. A key external factor relates to regulations (e.g., local, state, and federal laws), which force firms to adopt GSCM practices to reduce their environmental impact (Handfield et al., 1997). For example, several states (e.g., California and Oregon) in the US and export partners in European countries are increasingly implementing a green public procurement policy, which leads to new regulation-based contractual requirements (Gelderman et al., 2006; Sparreviks et al., 2018). And with US-only public procurement spending reaching $665bn in 2020 (US Government Accountability Office), many companies have been driven to adopt GSCM practices to ensure the green requirements set by the various state and federal governments are met (Kindalov & Snider, 2018). Similarly, an increasingly environmentally-aware consumer, customer, or stakeholder, who holds firms accountable not only for their environmental impact but also for how well they monitor their upstream suppliers' environmental impact, is another external factor that drives GSCM adoption (Delmas & Montiel, 2009; Hartmann & Moeller, 2014; Wilhelm et al., 2016; Chen & Ho, 2019; Duan et al., 2020). Particularly for dominant firms, as their market performance increases, their visibility increases, leading to heightened scrutiny of their environmental behavior from their stakeholders and consumers (Chen & Ho, 2019). Besides, organizations are also evolving with the society around them. Organizational behavior has been increasingly guided not only by self-interest and profit but also by an awareness of their social role and acceptable organizational behavior and conduct in the context of protecting the environment (Drumwright, 1994; Scott, 1995; Preuss, 2001; Murphy & Poist, 2003). Lastly, firms are becoming increasingly aware of the positive financial and social outcomes associated with GSCM adoption (Shittu & Bake, 2010; Blome et al., 2013), so they realize that it pays to be green.

While the external drivers of GSCM adoption have been widely investigated, less is known about the firm-specific drivers of GSCM adoption. GSCM adoption requires reshaping existing procurement and supplier practices and applying innovative solutions to make these practices more environmentally sustainable and less wasteful (Rainville, 2017; AL Nuaimi & Khan, 2019). Studies have found empirical support for capabilities such as innovation (Rainville, 2017; Cherrafi et al., 2018; AL Nuaimi & Khan, 2019; Seman et al., 2019), flexibility (Liu et al., 2019), and commitment to change (AL Nuaimi & Khan, 2019) are critical for successful GSCM implementation (Rainville, 2017; Cherrafi et al., 2018; AL Nuaimi & Khan, 2019; Seman et al., 2019). Moreover, GSCM adoption requires higher organizational flexibility to cater to GSCM practices' dynamic product and service customization requirements, such as changing production plans and system configurations while maintaining stable production performance. (Lu et al., 2019). Certain organizational capabilities can make them more adaptable and enable flexible operations (Teece, 2010). Some of the key factors that enable an organization to be flexible include training, employee knowledge, strategic planning, location, and inter-organizational relationships (Goes & Park, 1997; Feletto et al., 2011; Singh, 2014; Kumar & Singh, 2020).

Interestingly, while GSCM activities focus on waste reduction and efficiency, their adoption requires elements of change, innovation, and organizational flexibility, all of which require free resources above the firm's lean requirements or "slack" (Fisher, 1997; Christopher & Towill, 2000). Organizational slack can be defined as "the pool of resources in an organization that is over the minimum necessary to produce a given level of organizational output" (Nohria & Gulati, 1996, p. 1246). As many firms move towards GSCM, the challenge of determining the right balance between waste reduction as per lean and maintaining the critical buffer to adopt innovative and flexible capabilities to perform better at GSCM practices has become ever so important. Furthermore, as the availability or scarcity of resources in the environment can affect how the firm utilizes its existing resources and capabilities (Cunha et al., 2014), it is important to investigate the role of scarcity in the operating environment in a firm's ability to hold such resources. In fact, academic literature has highlighted that the firm's operating environment affects the relationship between the slack firm carries and it's financial (Kovach et al., 2015) and safety performance (Wiengarten et al., 2017). Drawing from the discussion above, our research aims to investigate the following research questions:

1. How do different types of organizational slack impact a firm's green supply chain management performance (GSCM)?
2. How does a firm's operating environment's resource scarcity impact these relationships?

We answer these questions by following the tenets of the natural resource-based view, conceptualizing slack as providing the capabilities needed by a firm to reach its green supply chain goals (Dougall et al., 2021). Specifically, we operationalize two types of slack: financial and operational slack, using publicly available data from Compustat and proprietary data from Sustainalytics databases. Results of a random effect model analysis indicate that the firm's financial slack, i.e., absorbed slack and unborrowed slack, have a positive effect with diminishing returns on its GSCM performance. Additionally, firms' capacity slack (a type of operational slack) has a positive effect with diminishing returns, and inventory slack (a different kind of operational slack) will have a negative effect with diminishing effect. Moreover, we found that the firm's operating environment scarcity positively moderates the relationship between inventory slack and absorbed slack on GSCM performances GSCM performance.

The theoretical contributions of this study are twofold. First, while operations management research has investigated the effect of slack on economic performance (Lawson, 2001; Hendricks et al., 2009; Modi & Mishra, 2011; Eroglu & Hofer, 2011), and safety performance (Wiengarten et al., 2017), none of these studies have considered the role that different types of slack have on a firm's environmental performance, which is one of the most important principles of green adoption. Furthermore, most operations management studies have concentrated on operational slack only (Hendricks et al., 2009; Azadegan et al., 2013; Kovach et al., 2015). We add financial slack to our analysis and take a more holistic approach. Moreover, our study contributes to other studies investigating the role of environmental factors as moderators of slack (Kovach et al., 2015; Wiengarten et al., 2017) in the context of GSCM performance. Additionally, we look at the synergy between lean and green by determining the balance between extra resources as an essential buffer vs. extra resources as waste (Modi & Mishra, 2011; Eroglu & Hofer, 2011). Second, we contribute to the GSCM and sustainable supply chain management literature that looks at firm-level drivers of GSCM performance (Rainville, 2017; Cherrafi et al., 2018; Seman et al., 2019; AL Nuaimi & Khan, 2019) by adding operational and financial slack as antecedents of GSCM performance (Green & Inman, 2011; Huo et al., 2019). Past literature has found that top management's commitment, innovation, and flexibility can positively impact the GSCM performance of the firm. (Menguc & Ozanne, 2005; Al Nuaimi & Khan, 2019)

Our study also offers considerable practical implications as it provides managers trying to implement GSCM performance. Specifically, we suggest how managers can effectively use the firm's lax financial and operational instruments to achieve higher GSCM performance. Additionally, our study provides additional guidance to firms operating in resource-dearth industries with limited opportunities.

Literature Review

Natural Resource-Based View

Natural Resource-Based View (NRBV) is an extension of the traditional resource-based theory (RBT) (Wernerfelt, 1984; Montgomery & Wernerfelt, 1988; Dierickx & Cool, 1989; Barney, 1991) that explains the conditions for sustained competitive advantage. According to RBT, a resource or capability that provides a sustained competitive advantage to a firm must be valuable, rare, inimitable, and non-substitutable (Barney, 1991). One of the main criticisms of RBT is the omission of environmental consequences that have been a pressing issue for several firms (Hart, 1995). NRBV is an alternative theory that extends the resource-based theory by suggesting that firms can sustain their competitive advantage by facilitating environmentally sustainable economic activity (Hart, 1995). Hart (1995) conceptualized three capabilities: pollution prevention, product stewardship, and sustainable development to achieve this goal. These capabilities aim at reducing the environmental impact of a firm and its products over its entire life cycle. "Pollution control" capability considers advanced waste and pollution minimization as a capability that leads to a firm's competitive advantage (Hart & Dowell, 2011; Shi et al., 2012). "Product/Process stewardship" emphasizes product sustainability over its lifecycle through engagement with external stakeholders by creating socially complex networks (Hart & Dowell, 2011; Shi et al., 2012). Finally, "sustainable development" involves a shared vision with other stakeholders to reduce environmental impact and improve a firm's long-term competitiveness.

In due course, sustainable development was split into two parts: "clean technology" and "foundation of the pyramid" (BoP) resources (Hart, 1997; Hart & Christensen, 2002). "Clean technology" refers to a firm's capability to modernize existing structures and processes to improve sustainability (Hart, 1997; Hart & Dowell, 2011). Finally, the "base of the pyramid" is a capability that aims to help emerging markets grow economically and socially (Hart & Christensen, 2002). A supply chain becomes difficult to replicate through these environmental and social capabilities and thus gains sustained competitive advantage. The driving forces, key resources, and competitive advantage drawn from each of these four capabilities are conceptualized by Hart and Dowell (2011) and are represented in Table 1.

Table 1: The Natural-Resource-Based View Principles (source: Hart & Dowell, 2011)

Strategic Capability	Societal Driving Force	Key Resource	Competitive Advantage
Pollution prevention	Minimize emissions, effluents, and waste	Continuous improvement	Lower costs
Product/Process stewardship	Lower product lifecycle cost	Stakeholder integration	Reputation/ legitimacy
Clean technology	Make quantum-leap improvement	Disruptive change	Future position
Base of the pyramid	Meet unmet needs of the poor	Embedded innovation	Long-term growth

Green supply chain management and NRBV

Drawing from the tenets of NRBV, GSCM is a set of environmentally sustainable economic activities through which firms can sustain their competitive advantage (Hart, 1995; Beamon, 1999). GSCM can be defined as a systematic closed-loop cycle supply chain that obtains only necessary resources using a green procurement design, is involved in green production, green distribution with an overall goal to reduce environmental waste while maintaining an increased integration with suppliers and customers (Song et al., 2015). Academic literature has used "green supply chain" synonymously with reverse logistics (Carter & Ellram, 1998; Fleischmann et al., 2003), closed-loop supply chain (Van Hoek, 1999; Beamon, 1999; Spengler et al., 2004; Steven, 2004; Inderfurth, 2004; Zhu & Sarkis, 2006), integrated supply chain (Preuss, 2001; Vachon & Klassen, 2006; Mezher & Ajam, 2006; Zhu & Sarkis, 2006), and sustainable supply chain (Beamon, 2005; Linton et al., 2007; Song et al., 2015). The core tenet of all these strategies is a focus on the environment.

Much of the research using NRBV has focused on pollution control. GSCM adoption has been associated with outcomes such as better financial, market performance (Blome et al., 2013), environmental performance, higher competitiveness, stakeholder satisfaction, and operational performance (Song et al., 2017; Mishra et al., 2019) which provide them with a sustained competitive advantage. Similarly, the proposed cost-reduction benefits around the tenets of pollution control have been supported empirically (Russo & Fouts, 1997; Mencug & Ozanne, 2005; Miemczyk et al., 2016).

The tenets of pollution controls or capabilities accumulated through experience, learning-by-doing, and continuous improvement have been used to study both internal and external drivers of GSCM (Shi et al., 2012). A firm's environmental behavior has been found to be impacted by external factors such as legislation, consumers' environmentalism or consumerism, and competition or stakeholder pressures (Williamson et al., 2006; Boiral, 2007; Darnall et al., 2008). On the internal level, the role of research and development has been identified as crucial while recognizing technologies that minimize negative environmental impact (Shrivastava, 1995) or increase energy conservation (Cordano et al., 2010), or reduce carbon emissions (Revell et al., 2010). Furthermore, a proactive environmental strategy has been linked with top management's commitment to encouraging employees to take innovative environmental actions (Ramus & Steger, 2000) and its marketing efforts to commercialize green products (Leonidou et al., 2017). Research has also found that innovation and commitment to change are key antecedents of GSCM adoption (Al Nuaimi & Khan, 2019). Similarly, researchers have argued that innovation capability is an intangible resource that is critical in GSCM adoption as firms need this capability to adapt to the changing operating environment associated with GSCM adoption (Kim et al., 2008). Moreover, a firm's entrepreneurial approach has been considered an antecedent to a firm's environmental commitment. Firms can take advantage of the flexibility to address the unique challenges, such as fluctuating customer preferences, cope with imperfect government regulations, and respond to uncertain market dynamics associated with green adoptions posed by the unique factors involved with green adoptions (Menguc & Ozanne, 2005). One such internal firm operational attribute that has been associated with increased flexibility is organizational slack (Kovach et al., 2015; Wiengarten et al., 2017)

Organizational Slack

Organizational slack refers to "the pool of resources in an organization that is over the minimum necessary to produce a given level of organizational output" (Nohria & Gulati, 1996,

p. 1246). Literature has described organizational slack under two categories: financial and operational slack (Xu et al., 2018).

A firm's financial slack is comprised of its absorbed, unabsorbed, and unborrowed slack (Cheng & Kesner, 1997; Tan & Peng, 2003; Wienngarten et al., 2017). The most liquid form of financial slack is unabsorbed slack, which represents readily available resources. Unabsorbed slack is the reserve of financial resources held in a company's financial instruments (Greve, 2003) and is measured by cash flows or marketable securities (Greve, 2003; Miller, 2003; Mishina et al., 2004; Voss et al., 2008). The absorbed slack represents the firm's non-liquid assets accumulated over time and exceeds what is needed for the maintenance of the production system, such as excess employees and storage (Greve, 2003). Unborrowed slack represents the possible resources that the firm can raise through various financial means, such as raising its debt levels (Cheng & Kesner, 1997). Unborrowed slack is the least available form of slack that can be re-deployed (Love & Nohria, 2005). The firm's financial slack is usually thought to be a crucial buffer for its activities (Cyert & March 1963; Thompson, 1967; Bourgeois, 1981), especially in a rapid-changing environment (Meyer, 1982). Firms lacking financial flexibility may experience shortages of funds, withdrawal from capital investments, or even bankruptcy (Wiengarten et al., 2017).

Operational slack represents the resource buffer available to support operations and enables firms to adjust better to demand and supply fluctuations (Kovach et al., 2015). Operational slack refers to excess operational capacity or/and inventory and helps firms effectively manage demand variation for their products (Sharfman et al., 1988; Palich et al., 2000). Conversely, having insufficient operational slack leads to inadequate responsiveness to demand fluctuations and reduced product delivery reliability (Wefald et al., 2010). If operational performance is operationalized as profits, cost, quality, delivery, and flexibility, reducing operational slack is likely to improve operational performance to a certain extent (Eroglu & Hofer, 2011, Modi & Mishra, 2011, Kovach et al., 2015). Decreased operational slack increases worker safety risks. However, worker safety risks increase when firms hold higher financial slack levels (Wiengarten, 2017). A reduction in operational slack is also linked to increased resource utilization efficiency and lowered pollution (King & Lenox, 2001). However, though researchers have conceptualized organizational slack in the form of excess resources as a driver of GSCM or other sustainable practices, none of the studies has empirically evaluated the relationship (Blome et al., 2013).

Traditionally, both financial and operational slack has been considered a helpful buffer (Bourgeois, 1981) for firms to survive environmental changes or supply chain disruptions (Hendricks et al., 2009), continue making a profit (Lawson, 2001), and innovate (Nohria & Gulati, 1996). Additionally, behavioral theorists have argued that slack resources can increase experimentation, innovation, and risk-taking (Cyert & March, 1963; Bromiley, 1991; George, 2005). Contrarily, the lean literature stream has highlighted the performance benefits of decreasing inventory levels and increasing inventory turns (Im & Lee, 1989; Crawford & Cox, 1990; Gilbert, 1990; Billesbach, 1991; Huson & Nanda, 1995; Balakrishnan et al., 1996). Researchers in this stream have even considered slack a waste that needs to be minimized (Lawson, 2001). However, researchers have recently pointed out the potential paradox of the effect of slack on performance and have highlighted that firm performance has an inverted U-shaped relationship with on-hand resources (Eroglu & Hofer, 2011; Modi & Mishra, 2011). An extremely lean operation is suspectable to any turbulence that might impact its operation or operating environment. To be better prepared for supply chain uncertainty, organizations often maintain a certain level of organizational slack.

Hypothesis Development

Organizational Slack and Green supply chain management Performance

GSCM goals are non-financial goals to reduce material waste through input raw material reduction, reuse, and recycling by modifying existing processes (Song et al., 2015). NRBV suggests that firms can gain sustained competitive advantage by facilitating environmentally sustainable economic activity through 4 strategic capabilities: pollution prevention, product/process stewardship, clean technology, and the base of the pyramid (Hart, 1995). Pollution control capabilities are such internal or external capabilities that are accumulated through experience, learning-by-doing, and continuous improvement (Hart & Dowell, 2011; Shi et al., 2012). Such internal and external capabilities drive sustained competitive advantage through green activities due to their causal ambiguity (Barney, 1991; Hart, 1995; Beamon, 1999). The concept of causal ambiguity refers to the difficulty of imitating business actions and outcomes (Lippman & Rumelt, 1982). Competitors will find it difficult to overcome an advantage by imitation if it is based on competencies with causally ambiguous characteristics (Reed & Defillippi, 1990). This makes imitation difficult.

Organizational slack is one such internal capability that provides the firm with the resources needed to respond quickly to changes in market demand or supply and adapt to uncertainty linked to GSCM adoption (Blome et al., 2014).

Some of the core GSCM processes are as follows (Islam et al., 2017):

a. Building green factories that use renewable energy LED lighting and collect rainwater.

b. Process improvements, such as improving the quality, productivity, and efficiency of production and adding technology to monitor, reduce and eliminate hazardous waste, water pollution, and greenhouse gases.
c. Adding new processes to maximum utilization of resources by reusing, recycling, refurbishing, and remanufacturing.
d. Building new efficient factories and adding new technology and processes to monitor, reduce and eliminate waste requires financial resources.

The above-mentioned new process involves remodeling the firms' supply chains to increase reusing, recycling, refurbishing, and remanufacturing while making sure that consumer needs and requirements are fulfilled. This remodeling can disrupt the supply as well as create demand variance. Thus, firms require extra employees and storage facilities and increased operational flexibility to deal with the uncertainty that may arise during the adoption of these new processes aimed at increasing the utilization of resources. Financial slack in the form of unabsorbed slack (cash flows or marketable securities) or unborrowed slack (debt or equity financing) provides the financial resources needed for the infrastructure, equipment, and new technology needed in the green factories. Financial slack also allows the firm to be flexible in dealing with the GSCM-related changes that can cause disruptions and supply and demand spikes. Additionally, absorbed slack can also provide flexibility concerning employee and storage facilities for the new processes and factories. A firm's financial slack, existing green capabilities, and firm internal processes widely differ based on industry, firm's strategy, and operational environment. Financial slack as a capability becomes engrained in the company process, becoming causally ambiguous, making it difficult to imitate. Thus, due to their causal ambiguity, financial slack drives sustained competitive advantage through GSCM performance.

Even though financial slack provides the relevant excess financial resources and safety nets while adopting these new processes, excessive financial slack can also lead firms to engage in unnecessary, potentially excessive risky projects that can reduce the efficiency of the GSCM adoption (Kim et al., 2008). Additionally, too much storage and equipment due to absorbed slack can also increase waste concerning resource consumption. Similarly, having too many employees increases resource stickiness, decreasing efficiency. This stems from the belief that human knowledge and skill tend to be embedded in specific tasks and organizational contexts, and task expertise is most often limited to narrow knowledge areas, making it harder to transfer from one task to another (Chi et al. 1988; Mishina et al., 2004). Overall, even though additional slack still has a positive effect on GSCM performance due to decreased accountability and efficiency, the strength of this positive relationship is diminished. Thus, we hypothesize:

H1: A firm's financial slack, i.e., a) unabsorbed slack, b) absorbed slack, and c) unborrowed slack, will have a positive effect with diminishing returns on its GSCM performance.

Operational slack refers to the firm's extra operational capacity and inventory (Kovach et al., 2015). GSCM adoption involves process improvements, new technology, and new processes enabling reusing, recycling, refurbishing, and remanufacturing. These new technologies and processes can lead to higher uncertainty due to both the demand and supply sides. The supply uncertainty may result from the raw material selection based on increased reusing, recycling, refurbishing, and remanufacturing principles. At the same time, demand uncertainty can stem from the customer's response to the new green products. Thus, the GSCM processes call for an increased firm's capability to be flexible to respond quickly to such changes (Günther & Scheibe, 2016). Operational slack can act as a cushion to deal with demand and supply fluctuations and provide the required operational flexibility; firms with higher operational slack can adjust their inventory and operational capacity considering both the new demand and the available supply. Additionally, firms' operational slack differs widely based on their industry, firms' exiting operational or lean strategy, and operational capacity. Operational slack as financial slack becomes a capability engrained in the company process, becoming causally ambiguous, making it difficult to imitate. Thus, due to their causal ambiguity, operational slack drives sustained competitive advantage through GSCM performance.

Even though operational slack provides flexibility, as it grows, the excess operational slack also increases waste. For example, too many unused production lines can increase material and energy waste. Similarly, extra inventory requires extra resources such as warehouses, lighting, and additional heating or cooling, thus increasing waste. Overall, even though operational slack still has a positive effect on GSCM performance due to increased flexibility, the strength of this positive relationship is diminished as operational slack increases. These reasonings lead to our second hypothesis:

H2: A firm's operational slack, i.e., a) capacity slack and b) inventory slack, will have a positive effect with diminishing returns on its GSCM performance.

The Moderating Effect of Environmental Scarcity

In the context of organizational slack, the organizational environment has been found to significantly shape firms' strategies and operational decisions. For example, Wiengarten et al. (2017) found that operating in markets that are characterized by high levels of dynamism, complexity, and munificence increases the likelihood of having a safety violation. Similarly, Kovach et al. (2015) found that as firms are less able to accurately plan production or respond to changes in demand, unpredictable and unstable markets are each negatively associated with firm performance. The dynamic market characteristics can put additional strains on a company's resources and might create tensions between safety and other operational outcomes.

As resource constraints are commonplace in the organizational world, our study focuses on a critical environmental factor that can affect the relationship between slack and GSCM performance: environmental scarcity. Environmental scarcity refers to the shortage of one or more critical resources needed by firms operating within an environment that may constrain their ability to grow (Randolph & Dess, 1984). Past literature suggests that scarcity can be seen as both a threat and an opportunity. However, concerning organizational slack, scarcity often acts as an opportunity. For example, Wiengarten et al. (2017) suggest that a company operating in a resource-scarce environment invests more in worker safety due to limited resource availability and growth opportunities, which can lead to a positive moderation of the relationship between slack and worker safety. Scarcity can constrain a firm from achieving its desired goals due to a lack of resources; however, firms may seize the scarcity as an opportunity, especially where competitors see it as an obstacle (Cunha et al., 2014). Resource scarcity in the environment can prevent complacency, increase organizational resilience, and increase efficiency (Hamel & Valikangas, 2003). Scarcity may lead to an attitude of organizational vigilance and may lead organizations to examine their environment and find untapped opportunities thoroughly (Hannan & Freeman, 1989). When the operating environment has scarce resources, scarcity can increase the effectiveness of using the different types of slack resources. As hypothesized earlier, financial and operational slacks provide the capabilities which lead to better GSCM performance. When the operating environment is scarce, firms' efficiency in utilizing the slack capabilities increases due to organizational vigilance, resilience, and decreased complacency. Thus, the relationship between financial and operational slack usage with GSCM performance is positively moderated by environmental scarcity.

H3: Environmental scarcity positively moderates the relationship between financial slack (a) unabsorbed slack, b) absorbed slack, and c) unborrowed slack) and operational slack (d) capacity slack, and e) inventory slack) on GSCM performance.

Method

To evaluate our hypotheses, we compiled a large panel dataset integrating data from two secondary sources: the Compustat and Sustainalytics databases. Following prior research, we used Standard & Poor's Compustat (Modi & Mishra, 2011; Kovach et al.,2015; Wiengarten et al.,2017) to collect firm-level financial and market information and Morningstar's Sustainalytics (Surroca et al., 2010; Wolf, 2013; Dai & Tang, 2022) to collect information on firm environmental, social and governance sustainability performance. Sustainalytics calculates a raw score for each firm using core and sector-specific metrics as the indicators across the three dimensions (Environment, Social, and Governance). Next, the raw scores are used to calculate a weighted score for each performance dimension. The weighted scores are calculated within each subindustry score and reflect a company's scores relative to its industry peers. The scores range between 0 and 100, 0 denotes a very poor performance, and 100 denotes an excellent performance.

As Sustainalytics comprises annual data, we used annual Compustat data while merging both databases. We included only publicly-owned manufacturing firms operating in the United States, as represented in the following 2-digit NAICS code (31-33). Sustainalytics data is available starting from 2009, so our dataset included firm-year observations from 2009 to 2018. Based on the above criteria, the final dataset included 2,059 firm-year observations from 307 firms. As a result of the unavailability of data for all firms across all time periods, our panel was unbalanced, and the observations per year were lower than what would be expected from a balanced panel.

Measures

The dependent variable in our analysis was the GSCM performance. We used the environment score from Sustainalytics, which is a composite aggregate using 57 individual indicators (please refer to Table 2 in the Appendix) to represent a firm's overall environmental performance and is released annually.

The independent variables in our analysis comprised the different subdimensions of financial slack and operational slack, and they were all calculated from variables found in the Compustat database. We included three types of financial slack in our model: unabsorbed, absorbed, and unborrowed. We measured unabsorbed slack using the quick ratio, calculated as current assets minus inventories scaled by current liabilities (Love & Nohria, 2005). Absorbed slack was measured as the ratio of selling, administrative, and general expenses by sales (Love & Nohria, 2005). Unborrowed slack was measured by financial leverage, which was calculated as the ratio of debt to equity (Love & Nohria, 2005).

Additionally, our model included the two kinds of operational slack, i.e., capacity slack and inventory slack. Capacity slack was measured as the ratio of annual sales to net property, plant, and equipment (SOP) (Chopra & Sodhi, 2004; Kleindorfer & Saad, 2005). Cash-to-cash cycle was used as a measure of inventory slack. Cash-to-cash cycle is the sum of days of inventory and days of accounts receivables - days of accounts payables. Days of inventory was calculated as 365 times the ratio of the average of beginning and ending inventory to the cost of goods sold.

Finally, we operationalized the moderator, environmental scarcity, as negative environmental munificence (Cunha et al., 2014; Chen et al., 2017) and calculated munificence by using a standardized measure of industry volatility of industry sales growth over five years (Boyd, 1995).

Controls

We included multiple control variables to account for other potential drivers of green SCM performance identified in previous literature. As larger firms may face stronger stakeholder pressure to increase their GSCM performance, we added firm size as a control in our model (Wang, 2020). Firm size was calculated as the ratio of the number of employees ('000) (Shalit & Sankar, 1977; Wiengarten et al., 2017). As market factors can also influence the GSCM performance, we followed previous literature and added market factors such as dynamism and complexity as controls (Boyd, 1995; Palmer & Wiseman, 1999; Li & Tang, 2010). Dynamism was operationalized using the standard error derived from the industry's annual sales regression over five years (Boyd, 1995). Complexity was operationalized as the Herfindahl-Hirschman Index (HHI), which is calculated by using the sum of the squared market shares of all firms in an industry group. The range of HHI is between 0 and 1, where scores close to one imply few competitors or dominant competitors with large market shares and less complex markets (Boyd, 1995). A firm's profitability may also affect its GSCM performance (Rahman et al., 2020), so we control for return on assets (ROA). ROA is calculated as the total income divided by the firm's total assets. As stakeholder pressure can affect a firm's green strategies and thus its GSCM performance (Chen & Ho, 2019), we included a control for stockholder pressure. We calculate stockholder pressure by dividing stockholders' equity by the firm's total sales (Rose & Giroux,1984). All the above measures were calculated using Compustat annual data. Similarly, a firm's governance can affect its GSCM performance (Craig & Dibrell, 2006). For this purpose, we added control for the governance score from Sustainalytics. To control for industry-specific characteristics that might impact GSCM performance, we added industry dummies at a 3-digits NAICS level. The complete list of Variables is provided in Table 3 in the Appendix.

We performed a natural logarithm transformation to inventory slack, capacity slack, absorbed slack, unborrowed slack, unabsorbed Slack, and firm size to correct their skewed distributions (Wiengarten et al., 2017). In addition, we winsorized log of capacity slack, log of inventory slack, log of absorbed slack, log of unabsorbed slack, log of unborrowed slack, munificence, ROA, stockholders' equity at 2nd and 98th percentile levels to mitigate the effect outliers and improve statistical efficiency and increase the robustness of statistical inferences (Hendricks & Singhal, 2009). The VIF of the independent variables was 5.73 and fell in the acceptable range (Hair et al., 1995) and hence the likelihood of multicollinearity affecting our results was low (Cohen et al., 2013). Furthermore, the IVs were found to be normally distributed as their skewness was between -2 to +2, and kurtosis was between -7 to +7 (Hair et al., 2010; Bryne, 2010). Table 5 presents the descriptive statistics, and Table 4 provides correlations between the variables.

Table 4: Pairwise Correlations

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	*GSCM performance*	1												
2	*log of Capacity Slack*	0.0274	1											
3	*log of Inventory Slack*	-0.0611*	0.0034	1										
4	*log of Absorbed Slack*	0.2129*	0.1999*	0.4657*	1									
5	*log of Unabsorbed Slack*	-0.0264	-0.0049	0.3134*	0.3296*	1								
6	*log of Unborrowed Slack*	0.0491*	-0.0292	-0.0852*	-0.0896*	-0.3801*	1							
7	*Env. Scarcity*	0.0103	-0.0773*	0.0966*	0.031	-0.0678*	0.1303*	1						
8	*HHI*	-0.0793*	-0.0384	-0.2029*	-0.1036*	-0.2621*	0.1633*	-0.0755*	1					
9	*Dynamism*	-0.1211*	-0.017	-0.0867*	-0.1551*	-0.1347*	0.0954*	0.4860*	0.0836*	1				
10	*ROA*	-0.1452*	0.2759*	-0.4512*	-0.5242*	-0.3213*	0.0206	-0.0825*	0.2414*	0.1360*	1			
11	*Firm Size*	0.4069*	0.0964*	-0.2546*	-0.1825*	-0.3991*	0.1651*	-0.0505*	0.0326	-0.0313	0.1616*	1		
12	*Stockholders' Equity*	0.0510*	-0.2296*	0.3607*	0.3976*	0.5051*	-0.4929*	0.0046	-0.3001*	-0.1786*	-0.6708*	-0.2466*	1	
13	*Governance Score*	0.2918*	-0.0076	-0.1149*	-0.0329	-0.1210*	0.0500*	0.0205	0.0828*	-0.0071	0.1256*	0.1343*	-0.1510*	1

* Indicates significance at 0.05 level

Table 5: Descriptive Statistics

Variable (N=2059)	*Mean*	*SD*	*Variance*	*Min*	*Max*	*Skewness*	*Kurtosis*
GSCM Performance	56.0363	13.2649	175.9580	23.7100	95.0000	0.3717	2.4836
log of Capacity Slack	1.5768	0.6687	0.4472	-0.2350	2.9711	-0.5224	3.1053
log of Inventory slack	4.4126	0.8333	0.6943	-0.9463	6.9741	-1.0489	6.6002
log of Absorbed Slack	-1.6874	0.8270	0.6840	-5.3831	3.0969	-0.9726	5.8226
log of Unabsorbed Slack	0.3816	0.5626	0.3165	-0.7502	1.9368	0.4218	3.0072
log of Unborrowed Slack	-0.5966	1.1990	1.4376	-4.6441	2.2416	-0.7096	5.2261
Env. Scarcity	-0.0405	0.0555	0.0031	-0.1446	0.0838	0.2314	2.3868
HHI	0.1600	0.1400	0.0200	0.0400	0.8400	1.8400	6.9400
Dynamism	1.0663	0.4995	0.2495	0.0925	1.8257	-0.0806	1.7850
ROA	0.8610	0.4077	0.1663	0.2386	2.1318	1.1409	4.2736
Firm Size	2.6205	1.1282	1.2729	-3.5066	5.3423	-0.0900	3.4867
Stockholders' Equity	0.6412	0.4471	0.1999	0.0022	2.3519	1.3103	4.9943
Governance Score	65.1920	8.0326	64.5234	42.0000	90.0000	0.0566	2.7505

Model and Results

We ran panel data regression using Stata 17.0 with the listed IVs and GSCM performance as our DV. Organizational slack might depend on the firm's strategy, and its effect on the firm's GSCM performance might vary from firm to firm. Thus we assume that there is a fixed difference (i.e., slope) between each level of individual slacks and the GSCM outcome. However, this fixed difference can vary across firms. Furthermore, from the data, we find that GSCM performance does not have much variance year over year, and the model R2 for between effect is much higher than the within effect (Within = 0.1570, Between = 0.3509), supporting our choice of random effect model. Thus, even with a significant Hausman test, we chose a random effect model for our analysis. Moreover, as the Wald test for groupwise heteroskedasticity was significant; thus, we used the robust option for all our analyses. To examine our hypothesis, we used xtreg Stata command with the robust option.

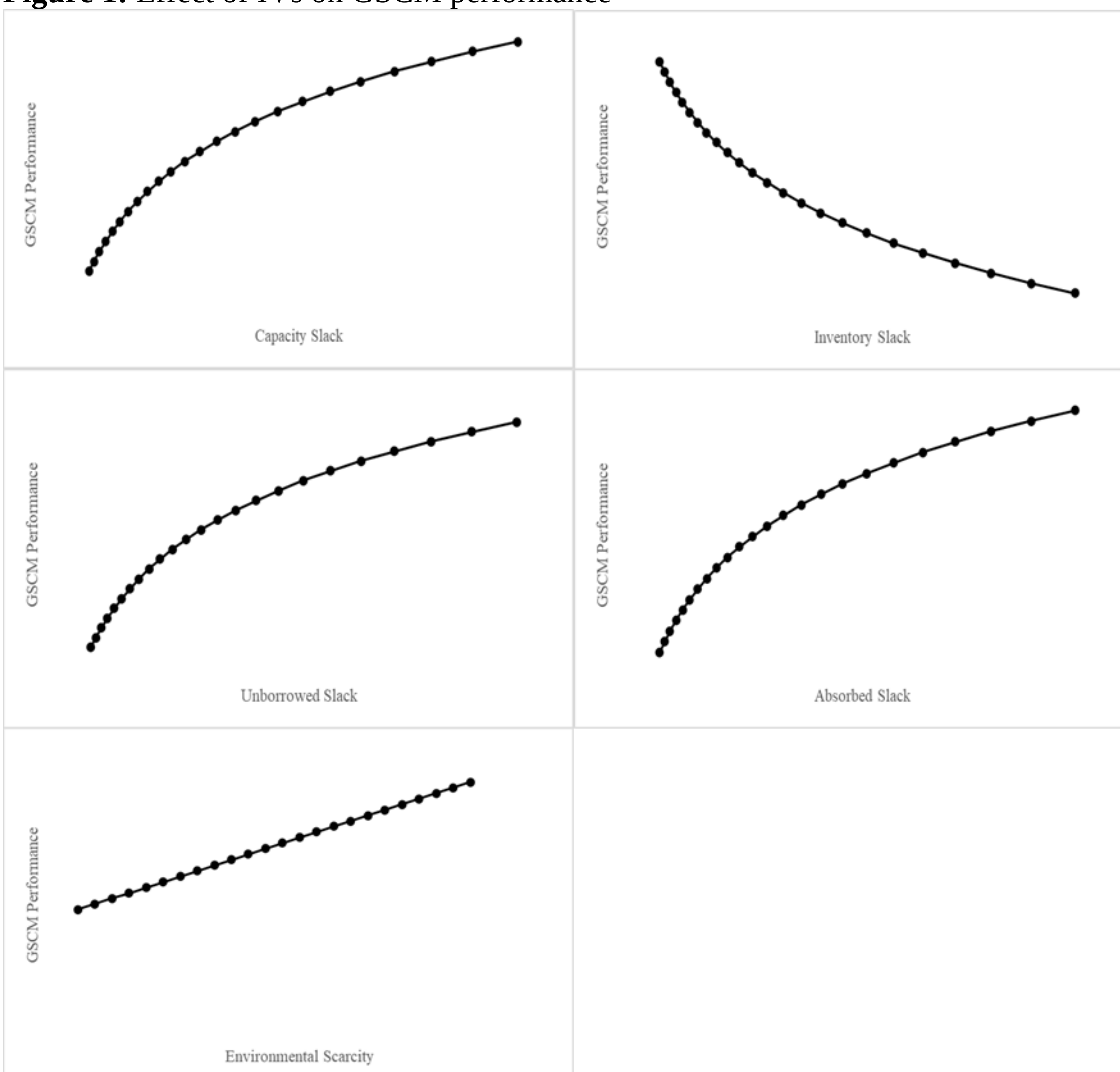
Table 6: Random Effect Regression Analysis with Robust Option

DV: GSCM Performance	**Model 0 (Control) Coef.**	**Model 1 Coef.**	**Model 2 Coef.**
log of Capacity Slack		2.0362**(0.7938)	1.6998**(0.7959)
log of Inventory Slack		-1.3685**(0.5313)	-1.001*(0.536)
log of Absorbed Slack		1.9720**(0.8879)	2.3917***(0.8999)
log of Unabsorbed Slack		-0.6038(0.5824)	-0.7780(0.6468)
log of Unborrowed Slack		0.9962***(0.3493)	0.9814***(0.3241)
Env Scarcity		14.8941***(4.6073)	10.8179(13.5836)
HHI	-7.1729(4.9854)	-6.8771(4.886)	-6.0369(4.8194)
Dynamism	0.2192(0.5087)	-0.5623(0.4668)	-0.5917(0.4509)
ROA	-7.1477***(1.5003)	-5.0730***(1.6858)	-5.1425***(1.6651)
Firm Size	5.0593***(0.5322)	4.7247***(0.5127)	4.6882***(0.5133)
Stockholders' Equity	-2.4039*(1.2807)	0.5288(1.3947)	0.4743(1.3607)
Governance Score	0.2916***(0.0477)	0.2764***(0.0482)	0.2760***(0.0474)
Capacity Slack X Munificence			-3.2810(4.225)
Inventory Slack X Munificence			5.4599**(2.5115)
Absorbed Slack X Munificence			8.3367**(3.7824)
Unabsorbed X Munificence			-2.6364(6.842)
Unborrowed Slack X Munificence			-0.4543(2.8595)
Constant	34.7235***(4.75)	40.6566***(5.5746)	40.3652***(5.5403)
Industry	Included	Included	Included
R^2	0.3397	0.3556	0.3565
N	2059	2059	2059

Note: two-tailed tests, ***, **, * indicate significance at 0.01,0.05,0.1 levels, with standard errors in parentheses. We used a 3-digit NAIC code instead of a four-digit NAICS code in the analysis to maintain the model fit.

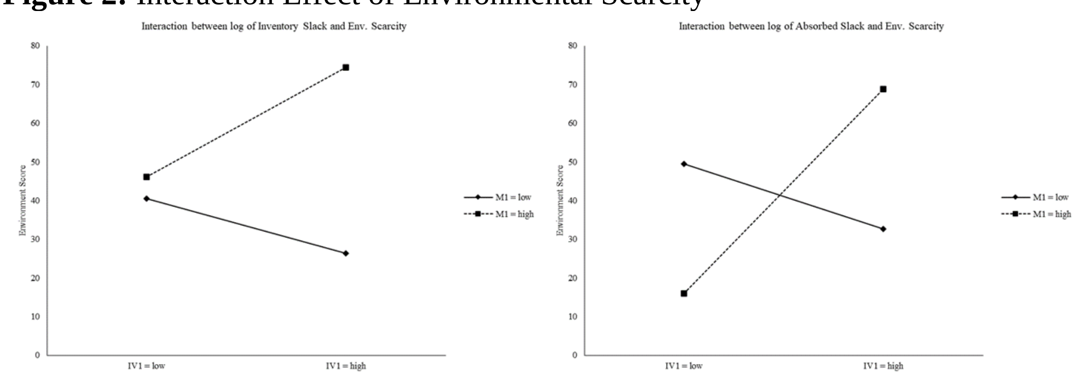
Table 6 presents the results from three models used to test our hypotheses. Model 0 only includes the control variables (R^2=0.3397, n = 2,059). Estimates in this model indicate that firm size (5.0593, *p<0.01*) and governance score (0.2916, *p<0.01*) have a positive effect on GSCM while ROA (-7.1477, *p<0.01*) or profitability have a negative relationship with GSCM performance. The R^2 score indicates that adding the controls significantly improved the model fit.

Figure 1: Effect of IVs on GSCM performance



Model 1 includes all hypothesized independent variables and controls (R^2=0.3556), reflecting the direct effects of the different dimensions of financial slack (H1) and operational slack (H2) on the firm GSCM performance. Model 1 estimates indicate that the log of absorbed slack (coefficient=1.9720, *p<0.05*) and log of unborrowed slack (coefficient= 0. 9962, *p<0.01*) have a significant positive relationship with the firm's GSCM performance, while the relationship between the log of unabsorbed slack (coefficient = -0.6038, *p>0.1*) with the firm's GSCM performance was not significant. In panel regression, the relationship between a logged IV and a non-logged DV indicates a diminishing marginal return in economics (Pedace, 2016). In simple terms, irrespective of the sign of the relationship (positive or negative), its impact decreases. Thus, a positive coefficient of logged IVs with a linear DV represents a positive effect with diminishing returns, while a negative coefficient of logged IVs with a linear DV represents a negative effect with diminishing returns (Pedace, 2016; Mackelprang et al., 2018; Tofallis, 2020). Additionally, referring to figure 1, we can see that both absorbed and unborrowed slack have a positive effect with diminishing returns on GSCM performance. Thus, H1(a) and H1(c) are supported, while H1(b) is not supported.

Figure 2: Interaction Effect of Environmental Scarcity



Next, the log of capacity slack (coefficient = 2.0362, *p<0.05*) has a positive relationship with the GSCM performance of the firm. However, contrary to our hypothesis, the log of inventory slack had a negative relationship with the GSCM Performance of the firm (coefficient =-1.3685, *p<0.05*). Referring to figure 1, we can see that capacity slack has a positive effect with diminishing returns on the firm's GSCM performance, while inventory slack has a negative effect with diminishing returns on the firm's GSCM performance. Hence, H2(a) is supported while H1(b) is not supported. Additionally, we see that environmental scarcity (coefficient = 14.8941, *p<0.01*) has a positive relationship with the GSCM performance. Referring to figure 2, we can see firms operating in scarce environments have higher GSCM performance.

Lastly, Model 2 examines the Hypothesis 3, which comprises the interaction effects of environmental scarcity on the relationships between the three dimensions of financial slack (a) unabsorbed slack, b) absorbed slack, c) unborrowed slack), as well as the two dimensions of operational slack (d) capacity slack, and e) inventory slack) and GSCM performance (R^2=0.3565). Results indicate that environmental scarcity has a positive moderating effect on the relationship between inventory slack (coefficient = 5.4599, *p<0.05*) and absorbed slack (coefficient=8.3367, *p<0.05*) on GSCM performances. For the other slacks, the moderation effect was not significant. Thus, H3b and H3d are supported, while H3a, H3c, and H3e were not supported.

Endogeneity Concerns

We justify our strategy in response to endogeneity concerns that may arise due to omitted variables through theoretical, contextual, and empirical arguments (Guide & Ketokivi, 2015; Lu & Shang, 2017). Simultaneity was unlikely to be a source of endogeneity concern in our sample as there was no theoretical justification for GSCM performance triggering slack changes.

Though some of the slack measures may be argued to be endogenous, finding an instrument for all the five types of slacks was non-tenable, given data availability. Researchers sometimes use lagged variables, but Rossi (2014) argues that instrumental variable regression should not be used when the only instruments available are lagged variables because this practice cannot be justified by economic arguments. As such, understanding this limitation, we ran a fixed-effect model with the same model specification for our robustness check. Lu et al. (2018) suggest that fixed-effect models are an effective way to deal with endogeneity. Furthermore, as Ketokivi & McIntosh (2017, p.7) state: "Applying instrumental variables amounts to trading one set of untestable assumptions for another, and using a bad instrument may well make things worse than sticking to OLS … This observation offers a segue to the next candidate solution for tackling endogeneity: instead of trying to produce better models, perhaps an actionable answer lies in getting better data." Being aware of these limitations, our empirical strategy consists of collecting and constructing control variables that have been alleged by the literature to influence the various slacks and GSCM performance. Following Shang et al. (2017), who used the control-variable approach instead of instruments, we did our best to include variables in our regression that, if omitted, could cause endogeneity problems. Despite our extensive set of controls, we acknowledge that eliminating endogeneity completely is unlikely, which is a limitation of this study.

Robustness Check

To ensure that our results are robust, we used fixed-effects linear regression and generalized estimating equation (GEE) for estimation. Using GEE, parameters of a generalized linear model with a potential correlation between outcomes and parameters can be estimated. GEE estimates are consistent in mild regularity conditions even if the covariance structure is misspecified. The results from the analysis are provided in Table 7. Results from the fixed-effect are in Models 3 and 4, and GEE analysis is in Models 5 and 6. The findings from the two models suggest that while the GEE model provides identical results, the fixed-effect model does not support the relationship between absorbed slack and GSCM performance. These results indicate the robustness of your initial model.

Table 7: Robustness/Endogeneity Analysis Using a Fixed Effect Model and GEE model

	FE		**GEE**	
DV: GSCM Performance	**Model 3 Coef.**	**Model 4 Coef.**	**Model 5 Coef.**	**Model 6 Coef.**
log of Capacity Slack	3.8997***(1.0819)	3.5710***(1.0693)	2.0366**(0.7881)	1.7009**(0.7892)
log of Inventory Slack	-0.8573(0.6113)	-0.4733(0.6167)	-1.3684***(0.5274)	-1.0006*(0.5314)
log of Absorbed Slack	0.0742(1.4996)	0.6008(1.5164)	1.9717**(0.8815)	2.3909***(0.8923)
log of Unabsorbed Slack	-1.2453**(0.6176)	-1.3581**(0.6657)	-0.604(0.5781)	-0.7785(0.6412)
log of Unborrowed Slack	1.1461***(0.4001)	1.1655***(0.3780)	0.9962***(0.3468)	0.9815***(0.3213)
Env Scarcity	15.5266***(4.7687)	4.4939(13.7391)	14.8941***(4.5736)	10.8142(13.4676)
HHI	-0.2908(7.7068)	1.1570(7.2295)	-6.8763(4.8505)	-6.0342(4.7789)
Dynamism	-0.3874(0.4577)	-0.3990(0.4376)	-0.5622(0.4634)	-0.5916(0.4471)
ROA	-6.5722***(1.9595)	-6.6556***(1.9333)	-5.0733***(1.6735)	-5.1435***(1.6510)
Firm Size	5.8559***(1.1546)	5.6740***(1.1756)	4.7247***(0.5089)	4.6883***(0.5091)
Stockholders' Equity	0.4239(1.5989)	0.4116(1.5614)	0.5288(1.3845)	0.4744(1.3492)
Governance Score	0.2525***(0.0520)	0.2499***(0.0512)	0.2764***(0.0479)	0.2760***(0.0470)
Capacity Slack X Scarcity		-2.0219(4.3198)		-3.2798(4.1889)
Inventory Slack X Scarcity		5.6649**(2.5617)		5.4600**(2.4900)
Absorbed Slack X Scarcity		6.4662*(3.8199)		8.3362**(3.7501)
Unabsorbed X Scarcity		-1.0309(6.9358)		-2.6347(6.7836)
Unborrowed Slack X Scarcity		-0.0601(2.9799)		-0.4538(2.8351)
Constant	29.6268***(6.3783)	29.8271***(6.5186)	40.6550***(5.5340)	40.3609***(5.4934)
Industry	Included	Included	Included	Included
R^2	0.2258	0.2337		
χ^2			497.97	513.95
N	2059	2059	2059	2059

Note: two-tailed tests, ***, **, * indicate significance at 0.01,0.05,0.1 levels, with standard errors in parentheses. We used a 3-digit NAIC code instead of a four-digit NAICS code in the analysis to maintain the model fit.

Additionally, we tried to use an alternative dependent variable in our model in order to rule out any measurement errors. Instead of the environment score, we used the Total ESG (Economic, Social, and Governance) score, which is a composite measure of the overall sustainability effort of the firm. This measure encompasses the firm's environmental, social, and governance efforts concerning its sustainability goals. We chose this alternate DV as firms with better GSCM performance might have better overall sustainability performance. We used a random-effects model as used in our main model keeping all other variables the same. The results (Table 9) support all but one of our original findings: we could not find support for the interaction between inventory slack and environmental scarcity.

Table 9: Robustness Analysis Using an Alternate Dependent Variable

DV: Total ESG Score	**Model 11** **Coef.**	**Model 12** **Coef.**
log of Capacity Slack	0.9542*(0.5107)	0.8320(0.5059)
log of Inventory Slack	-1.0459***(0.3264)	-0.9011***(0.3272)
log of Absorbed Slack	0.6524(0.5456)	0.9562*(0.5616)
log of Unabsorbed Slack	-0.4083(0.3634)	-0.5535(0.3938)
log of Unborrowed Slack	0.5966***(0.2022)	0.4874**(0.2044)
Env Scarcity	6.8231**(2.787)	10.6494(8.1868)
HHI	-1.9710(2.8562)	-1.1520(2.8701)
Dynamism	-0.6247**(0.2819)	-0.7660***(0.2790)
ROA	-3.4952***(1.0116)	-3.5091***(1.0081)
Firm Size	2.6710***(0.3140)	2.6433***(0.3094)
Stockholders' Equity	-0.0395(0.8386)	-0.1234(0.8286)
Governance Score	0.5100***(0.0255)	0.5105***(0.025)
Capacity Slack X Scarcity		0.7854(2.5330)
Inventory Slack X Scarcity		1.411(1.5431)
Absorbed Slack X Scarcity		5.9147***(2.2544)
Unabsorbed X Scarcity		-3.1795(3.9261)
Unborrowed Slack X Scarcity		-1.8757(1.5676)
Industry	Included	Included
Constant	26.2225***(3.1079)	26.3554***(3.0765)
R^2	0.5040	0.5038
N	2059	2059

Note: two-tailed tests, ***, **, * indicate significance at 0.01,0.05,0.1 levels, with standard errors in parentheses. We used a 3-digit NAIC code instead of a four-digit NAICS code in the analysis to maintain the model fit.

Discussion of Results

We used longitudinal-secondary data and multiple financial and operational slack measures and included various robustness checks to answer our three research questions. The answer to our first question, "How do different types of organizational slack impact a firm's green supply chain management performance (GSCM)?" is it depends on the type of slack. Our findings indicate that, among the three types of financial slack, while absorbed slack and unborrowed slack have a significant positive effect with diminishing returns on its GSCM performance, unabsorbed slack did not affect GSCM performance. Some slack in non-liquid assets in the form of excess employee and storage capacity and the possibility of resources that the firm can raise through other financial means have a positive relationship with the GSCM performance of the firm. However, higher levels of absorbed slack can increase the waste arising from these processes and maintaining these resources such as facilities, and a higher amount of unborrowed slack can reduce accountability and efficiency; thus, we may see their positive effect with diminishing returns on its GSCM performance. In contrast, the non-significant relationship between unabsorbed slack and GSCM performance indicates that companies that carry extra cash may not care about their environmental performance. This inference might also be supported by the negative relationship between ROA and GSCM performance.

In terms of operational slack, we found that while capacity slack has a positive effect with diminishing returns on the firm's GSCM performance, inventory slack has a negative effect with diminishing returns on the firm's GSCM performance. While having some extra operational capacity is beneficial for the GSCM performance, carrying extra inventory is detrimental to the GSCM performance of the firm. However, too much operational slack can increase material and energy waste and impair GSCM performance; thus, we may see their positive effect with diminishing returns on its GSCM performance. These findings echo the findings of Eroglu and Hofer (2011), who had linked inventory leanness with a positive and non-linear effect on the firm performance. They had found that inventory leanness had a concave relationship implying– beyond a certain point, leanness has negative effects on financial performance.

The answer to our second question, "How does a firm's operating environment's resource scarcity impact these relationships?" The findings of this study suggest that environmental scarcity has a positive moderating effect on the relationship between inventory slack and absorbed slack on GSCM performance. On the other hand, there was no moderating effect of environmental scarcity on the other types of slack. It means as the scarcity in the operating environment amplifies the (-ve) effect of inventory slack and (+ve) effect of absorbed slack on GSCM performance. This indicates that carrying the excess employee and storage capacity helps more with respect to the GSCM performance when the operating environment is scarce. The results also suggest that carrying extra inventory becomes more detrimental to GSCM performance. However, the relationships between the possibility of resources that the firm can raise through other financial means or the extra operational capacity that the firm might carry and the GSCM performance of the firm are not affected by the environmental scarcity.

Research Implications and Contributions

Theoretical Contributions

The results of this study offer relevant contributions to the literature. First, we add to the literature stream that has studied the organizational outcomes of slack. Studies have found conflicting results on the benefits of slack. While some found that less slack is beneficial (King& Lenox, 2001), others found it to be detrimental (Wiengarten, 2017). This indicates that the effect of different types of slack on performance is contingent on the context being investigated.

Researchers have found that the right levels of operational slack would likely improve operational performance (Eroglu & Hofer, 2011, Modi & Mishra, 2011, Kovach et al., 2015). Others have highlighted how decreased operational slack increases worker safety risks; however, when firms hold higher financial slack levels, the effect of operational slack on worker safety risks is weakened (Wiengarten, 2017). Reduced operational slack has also been linked to increasing resource utilization efficiency and thus lowering pollution (King & Lenox, 2001). While some researchers have conceptualized organizational slack or excess resources as a driver of sustainable practices, none of the studies has empirically evaluated it (Blome et al., 2013). Our study adds to the slack conversation by providing theoretical and empirical support by looking at the effect of the various dimensions of slack on the green sustainability performance of the firm. The results indicate that absorbed slack, unborrowed (financial slack), and capacity slack (operational slack) have a significantly positive effect with diminishing returns on GSCM performance. In contrast, inventory slack (operational slack) has a significant negative effect with diminishing returns on its GSCM performance.

Secondly, our study adds to the green sustainability literature stream by adding the various financial and operational slacks as antecedents of GSCM performance. Previous studies on GSCM have mostly concentrated on outcomes of GSCM adoption such as better financial, market performance (Blome et al., 2013), environmental performance, higher competitiveness, stakeholder satisfaction, and operational performance (Song et al., 2017; Mishra et al., 2017). A few studies have looked at antecedents such as innovation, commitment to change adoption (Al Nuaimi, Khan, 2019), intra- and inter-organizational environmental practices (Shi et al., 2012) as capabilities that can lead to better environmental performance (Shi et al., 2012), entrepreneurial approach (Menguc & Ozanne, 2005) as antecedents of environmental performance. We conceptualize slack as a capability that provides the financial resources and the flexibility needed to handle the demand and supply-side disruptions linked with GSCM performance.

Lastly, we add to the literature that looks at the effect of the firm's operating environment on its performance. Extant literature has found that the firm's operating environment can affect the relationship between organizational slack and specific outcomes, such as its financial performance (Kovach et al., 2015) and safety performance (Wiengarten et al., 2017), but in different ways. Kovach et al. (2015), for example, found support for a positive moderation of environmental instability on the relationship between capacity slack and firm performance. Conversely, Wiengarten et al. (2017) found that scarcity was advantageous for the firm, as it negatively moderates the relationships between slack and safety violations. Indeed, past literature suggests that scarcity can be seen as both a threat (Cunha et al.,2014) and an opportunity (Hannan & Freeman, 1989; Hamel & Valikangas, 2003). Like Wiengarten et al. (2017), our study adds GSCM performance to the list of outcomes where environmental scarcity acts as an opportunity for firms to increase efficiency and decrease waste. Our results suggest that environmental scarcity directly affects GSCM performance, but it also positively moderates the relationship between inventory slack and absorbed slack on GSCM performance.

Managerial Contributions

Our study offers significant practical implications for executives and supply chain managers in the pursuit of delineating the extent to which different levels of resources are needed to achieve higher GSCM performance. First, our results suggest that holding absorbed slack, i.e., excess employees and storage capacity, can provide supply chain managers the available laxity to handle the uncertainties associated with GSCM adoption and thus have a better GSCM performance. The relationship between absorbed slack and GSCM performance was found to be positive but with diminishing marginal returns. Thus, SCM managers should adjust their excess employees and storage capacity to maximize its positive effect on GSCM performance based on the firm's operational and environmental strategy. We also found that unborrowed slack, i.e., the possibility of resources that the firm can raise through other financial means, has a positive relationship with the GSCM performance of the firm. Managers can utilize these unrealized financial resources to deal with the uncertainties associated with GSCM adoption and improve their GSCM performance. Thus, having the ability to raise money from the market can be helpful in achieving better GSCM performance. Similar to the relationship between absorbed slack and GSCM performance, the relationship between absorbed slack and GSCM performance is decreasingly positive. Based on the firm's operations, SCM managers can adjust the level of unborrowed slack they should use to maximize its effect on GSCM performance.

Second, our results suggest that slack operational capacity can allow firms to handle better the uncertainties associated with GSCM adoption. We found that the relationship between capacity slack and GSCM performance was positive but with diminishing marginal returns. SCM managers can adjust these excess employees and storage capacity to maximize their effect on GSCM performance based on the firm's operations. However, the firms should also avoid having too many employees and too much storage capacity, as at higher levels, they may not add much value to the firm's GSCM performance. Thus based on the firm's strategy and its desired GSCM goals, maintaining the optimal level of employees and storage capacity can help achieve these goals. Conversely, we find that slack inventory can negatively impact GSCM performance. So SCM managers should optimize their inventory to as-needed levels and avoid carrying extra inventory whenever possible to achieve better GSCM performance.

Third, we have additional recommendations for managers working in the resource-scarce industries devoid of opportunities. All the already discussed strategies still hold good for firms working in such industries. Additionally, our results indicate that resource scarcity enhances the previously discussed relationship between absorbed and capacity slack on GSCM performance. Thus the supply chain managers working in such resource-scarce industries, trying to achieve higher GSM performance, should be extra vigilant about carrying the optimal inventory as having the extra inventory has an even higher detrimental effect on GSCM performance for such industries. Conversely, the environmental scarcity can enhance the positive effect of having extra employees and storage capacity on GSCM performance. Thus the managers in resource-scarce industries should always maintain the slack with respect to employees and storage capacity to ensure higher GSCM performance.

Limitations and Directions for Future Research

We acknowledge that our study has limitations. First, we use the environment score from a single source (from Sustainalytics) as a proxy for environmental performance. There might be bias associated with data collection and measurement errors that might impact our study. Future research can look at other possible sources and other possible proxies to capture the firm's GSCM performance in a better manner. Similarly, GSCM performance also depends on the green performance of upstream suppliers of a firm. So future studies can create a better measure of GSCM performance by network modeling that captures the GSCM of supply chain networks with the firms as a node.

Second, our study considers GSCM performance in totality. However, GSCM adoption consists of multiple independent and overlapping tasks with their own performance measures. Thus, future research can look into how the various financial and operational slacks impact these individual task performances. Additionally, rather than only looking at GSCM performance, researchers can study the optimal levels of slack that can heighten the triple performance of a firm (social, environmental, financial) when slack levels are a firm decision/strategy. It could be that we have a trade-off situation, highlighting that firms need to decide on their priority. Similarly, researchers may also find the right level of slack that might help firms balance green and stakeholder pressure and maintain high stock market valuations.

Third, our sample includes only publicly listed US companies. Future research should examine the impact of various forms of slack on GSCM performance in other regions, cultures, and privately owned firms. In this study, as a method, we only used secondary data to explore our research questions. Although this adds needed objectivity to sustainability research, it also confines us to a relatively high or abstract level of analysis.

Finally, we are fully aware of the endogeneity concerns that could not be fully addressed due to data constraints. We try to mitigate it by adding necessary controls and running multiple robustness checks.

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Appendix

Table 2: Individual Indicators Used for Calculating Environment Score in Sustainalytics

1	Formal Environmental Policy
2	Environmental Management System
3	External Certification of EMS
4	Environmental Fines and Non-monetary Sanctions
5	Participation in Carbon Disclosure Project (Investor CDP)
6	Scope of Corporate Reporting on GHG Emissions
7	Programmes and Targets to Reduce GHG Emissions from own operations
8	Programmes and Targets to Increase Renewable Energy Use
9	Carbon Intensity
10	Carbon Intensity Trend
11	% Primary Energy Use from Renewables
12	Operations Related Controversies or Incidents
13	Reporting Quality Non-Carbon Environmental Data
14	Programmes and Targets to Protect Biodiversity
15	Guidelines and Reporting on Closure and Rehabilitation of Sites
16	Environmental and Social Impact Assessments
17	Oil Spill Reporting and Performance
18	Waste Intensity
19	Water Intensity
20	Percentage of Certified Forests Under Own Management
21	Programmes & Targets to Reduce Hazardous Waste Generation
22	Programmes & Targets to Reduce Air Emissions
23	Programmes & Targets to Reduce Water Use
24	Other Programmes to Reduce Key Environmental Impacts
25	GHGReductionProgramme
26	Programmes and Targets to Improve the Environmental Performance of Own Logistics and Vehicle Fleets
27	Programmes and Targets to Phase out CFCs and HCFCs in Refrigeration Equipment
28	Formal Policy or Programme on Green Procurement
29	Environmental Supply Chain Incidents
30	Programmes to Improve the Environmental Performance of Suppliers
31	External Environmental Certification Suppliers
32	Programmes and Targets to Stimulate Sustainable Agriculture
33	Programmes and Targets to Stimulate Sustainable Aquaculture/Fisheries
34	Food Beverage & Tobacco Industry Initiatives
35	Programmes and Targets to Reduce GHG Emissions from Outsourced Logistics Services
36	Data on Percentage of Recycled/Reused Raw Material Used
37	Data on Percentage of FSC Certified Wood/Pulp as Raw Material
38	Programmes and Targets to Promote Sustainable Food Products
39	Food Retail Initiatives
40	Products & Services Related Controversies or Incidents
41	Sustainability Related Products & Services
42	Revenue from Clean Technology or Climate Friendly Products
43	Automobile Fleet Average CO2 Emissions

44 Trend Automobile Fleet Average Fleet Efficiency

45 Products to Improve Sustainability of Transport Vehicles

46 Systematic Integration of Environmental Considerations at R&D Stage (Eco-design)

47 Programmes and Targets for End-of-Life Product Management

48 Organic Products

49 Policy on Use of Genetically Modified Organisms (GMO) in Products

50 Environmental & Social Standards in Credit and Loan Business

51 Responsible Asset Management

52 Use of Life-Cycle Analysis (LCA) for New Real Estate Projects

53 Programmes and Targets to Increase Investments in Sustainable Buildings

54 Share of Property Portfolio Invested in Sustainable Buildings

55 Sustainability Related Financial Services

56 Products with Important Environmental/Human Health Concerns
Carbon Intensity of Energy Mix

57

Table 3: Variable Definition and Operationalization

Dependent Variable:	*Definition*	*Measure*
GSCM Performance	GSCM is a systematic closed-loop cycle supply chain that obtains only necessary resources using a green procurement design, participates in green production, green distribution with an overall goal to reduce environmental waste while maintaining an increased integration with suppliers and customers (Carter & Ellram's, 1998; Song et al., 2017).	Source: Sustainalytics. A composite aggregate using 56 individual indicators to represent a firm's overall environmental performance.
Independent Variables:		
Financial Slack		
Unabsorbed Slack	Unabsorbed slack is the reserve of financial resources held in a company's financial instruments (Greve, 2003) and is measured by cash flows or marketable securities (Greve, 2003; Miller, 2003; Mishina et al., 2004; Voss et al., 2008).	Source: Compustat Annual. Measured by the quick ratio, which is calculated as current assets minus inventories scaled by current liabilities.
Absorbed slack	The absorbed slack of a firm represents its non-liquid assets that have been accumulated over time and exceed what is needed for the maintenance of the production system (Greve, 2003). Excess employees and storage capacity are examples of such slack.	Source: Compustat Annual. Measured as the ratio of selling, administrative, and general expenses to sales (SGandA/sales) (Love and Nohria, 2005).
Unborrowed slack	Unborrowed slack represents the possible resources that the firm can raise through various financial means, such as raising its debt levels (Cheng & Kesner, 1997). Unborrowed slack is the least available form of slack that can be re-deployed (Love & Nohria, 2005).	Source: Compustat Annual. Measured by financial leverage, calculated as the ratio of debt to equity (Palmer & Wiseman, 1999).
Operational Slack		
Capacity slack	Slack in operational capacity (Kovach et al., 2015).	Source: Compustat Annual. The ratio of annual sales to net property, plant, and equipment (SOP) (Chopra & Sodhi, 2004; Kleindorfer & Saad, 2005)
Cash to cash cycle	Slack in inventory (Kovach et al., 2015).	Source: Compustat Annual. Cash-to-cash cycle is the sum of days of inventory and days of accounts receivables - days of accounts payables. Days of inventory is calculated as 365 times the ratio of the average of beginning and ending inventory to the cost of goods sold
Moderators:		
Environmental Scarcity	Environmental scarcity refers to the inadequacy of one or more critical resources needed by firms operating within an environment (Randolph and Dess,1984)	Source: Compustat Annual. Operationalized as negative munificence. Munificence is calculated using a standardized measure of industry volatility of industry sales growth over a 5-year period (Boyd, 1995).
Controls:		
Net Sales		Source: Compustat Annual. The sum of a company's gross sales minus its returns, allowances, and discounts
Return on Assets		Source: Compustat Annual. Return on assets (ROA) indicates how profitable a company is relative to its total assets. ROA= Total Income/Total Asset
Dynamism	Dynamism measures the volatility of the environment and is a key dimension of market uncertainty and increasing levels of dynamism are associated with greater levels of uncertainty (Boyd, 1995).	Source: Compustat Annual. Operationalized using the standard error derived from the industry's annual sales regression over a 5-year period (Boyd, 1995).
Complexity	The complexity of a market indicates the degree of inequity among competitors and is positively associated with uncertainty (Dess and Beard, 1984).	Source: Compustat Annual Operationalized as the Herfindahl-Hirschman Index (HHI), calculated using the sum of the squared market shares of all firms in an industry group.
Firm Size		Source: Compustat Annual The ratio of numbers of employees to firm sales (; Mishina et al., 2004; Vanacker et al., 2013; Lecuona & Reitzig, 2014; Paeleman & Vanacker, 2015).
Stockholders' Equity		Source: Compustat Annual The ratio of the Stockholder's Equity by Net Sales
Governance Score		Source: Sustainalytics A composite score for sustainability governance of the firm

Table 8: Robustness Analysis Using Lagged DV and Industry Dummies at NAICS- 2 digits

	Lagged DV		NAICS-2	
DV: GSCM Performance	**Model 7 Coef.**	**Model 8 Coef.**	**Model 9 Coef.**	**Model 10 Coef.**
lagged log of Capacity Slack	1.9553***(0.7267)	1.6260**(0.74)	2.2311***(0.7847)	1.8874**(0.7833)
lagged log of Inventory Slack	-0.3588(0.5251)	-0.0725(0.5355)	-1.3860***(0.5215)	-1.0240*(0.5286)
lagged log of Absorbed Slack	1.8006**(0.8763)	2.1777**(0.8938)	2.6926***(0.7615)	3.1478***(0.7723)
lagged log of Unabsorbed Slack	-0.8995*(0.5332)	-0.9109(0.6082)	-0.3797(0.5720)	-0.5976(0.6356)
lagged log of Unborrowed Slack	0.6553**(0.2682)	0.6341**(0.2786)	0.9497***(0.3435)	0.9387***(0.3171)
lagged Env Scarcity	17.2578***(3.9529)	5.8108(12.3827)	13.6999***(4.5571)	10.965(13.3368)
HHI	-2.1767(4.7724)	-2.1651(4.7475)	-6.4703(4.2556)	-5.8092(4.1764)
Dynamism	-0.8183**(0.4133)	-0.7384*(0.4148)	-0.6185(0.4647)	-0.6755(0.4474)
ROA	-5.3358***(1.4680)	-5.4979***(1.4420)	-5.4589***(1.6402)	-5.4590***(1.6157)
Firm Size	4.7975***(0.5130)	4.7345***(0.5090)	4.8841***(0.4901)	4.8744***(0.4854)
Stockholders' Equity	-0.5975(1.1182)	-0.7444(1.128)	0.5291(1.3866)	0.4952(1.3516)
Governance Score	0.1922***(0.0479)	0.1934***(0.0468)	0.2779***(0.0478)	0.2776***(0.0469)
Capacity Slack X Scarcity		2.1222(3.8407)		-2.7635(4.1865)
Inventory Slack X Scarcity		-5.0878**(2.1756)		5.4403**(2.4906)
Absorbed Slack X Scarcity		-5.3946(3.5635)		9.1348**(3.6569)
Unabsorbed X Scarcity		-0.6585(6.3048)		-3.7149(6.8048)
Unborrowed Slack X Scarcity		0.4218(2.9770)		-0.2869(2.8231)
Industry	Included	Included	Included at NAICS2	Included at NAICS2
Constant	43.1170***(5.5986)	43.2597***(5.5955)	41.8412***(5.3256)	41.5854***(5.3228)
R^2	0.3597	0.3601	0.3139	0.3173
χ^2			279.09	310.03
N	1783	1783	2059	2059

Note: two-tailed tests, ***, **, * indicate significance at 0.01,0.05,0.1 levels, with standard errors in parentheses. We used a 3-digit NAIC code instead of a four-digit NAICS code in the analysis to maintain the model fit.