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# The moderating role of supplier relationship on the effect of postponement on supply chain resilience under different levels of environmental uncertainty

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## ABSTRACT

The purpose of this study is to examine the relationship between postponement and supply chain resilience (SCR), as well as to explore the separate and combined moderating effects of supplier relationship (SR) and environmental uncertainty (EU) on that relationship. Based on the survey data from 261 manufacturing SMEs in the Sana'a and Taiz regions in Yemen, the proposed relationships in the research model were tested. Our empirical results reveal that postponement positively and significantly affects SCR. Furthermore, SR strengthens the postponement-SCR relationship under a lower level of EU. The results of this paper provide useful insights for managers and decision-makers of SMEs, who are expected to show a greater interest in building long-term relationships with suppliers. This has implications that by building a strong SR, SMEs are expected to be able to leverage the full potential of postponement to enhance SCR at a low level of EU.

**KEYWORDS:** Supply chain resilience postponement supplier relationship environmental uncertainty SMEs

In this article

## 1. Introduction

In today's dynamic environment, a great deal of interest in supply chain management literature has focused on managing disruptions caused by unanticipated and unplanned occurrences inside a supply chain (SC; e.g. Al-Hakimi et al., [2021a](#); Gualandris & Kalchschmidt, [2015](#); Lee, [2004](#); Tang, [2006a](#); Wagner et al., [2012](#)). SC disruption is 'an event that disrupts the flow of goods or services in SC (Ambulkar et al., [2015](#), p. 111),' which can negatively affect firm performance (Narasimhan & Talluri, [2009](#)). Accordingly, most manufacturing firms strive to face disruption in SC by building resilience (Al-Hakimi et al., [2021b](#); Carbonara & Pellegrino, [2018](#); Namdar et al., [2018](#); Rajesh, [2021](#)) as a core capability to respond to disturbances and maintain processes (Behzadi et al., [2020](#); Hohenstein et al., [2015](#); Liu et al., [2017](#); Sheffi & Rice, [2005](#)). Resilience is often thought of as the ability of supply chain systems to manage and take advantage of adverse situations (Rajesh et al., [2021](#)). In this study, we define supply chain resilience (SCR), drawing on the research work of Ponomarov and Holcomb ([2009](#), p. 131), as 'an adaptive capability of the SC to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function.' Much has been published about factors that mitigate the effects of disruptions in SCs and enhance their resilience (Ali et al., [2017](#); Goail & Al-Hakimi, [2021](#); Tukamuhabwa et al., [2015](#)). A proven appealing option for mitigating SC disruptions is to postpone the production or distribution of the demand above the base level (Carbonara & Pellegrino, [2018](#); Christopher & Holweg, [2011](#); Gualandris & Kalchschmidt, [2015](#); Seth & Panigrahi, [2015](#); Xiaoxun & Jiajun, [2016](#)). Postponement is seen as delaying activities within SC until more information is available regarding the customer order (Carbonara & Pellegrino, [2018](#)). This enables reducing or mitigating the demand uncertainty by postponing the necessary operations to meet it (Forza et al., [2008](#)). Thus, it allows firms to retain their capacity to adapt to consumers' ever-changing orders (Saghiri & Hill, [2014](#)). However, no empirical research has taken into account the relationship of postponement to SCR. To address the current shortcomings in academic literature, the following research question is proposed:

RQ1: How postponement influences SCR?

Postponement is widely recognized, as an effective strategy for building resilience by dealing with disruptions along with the entire SC (Tang, [2006b](#); Yang & Yang, [2010](#)). Postponement allows for the potential to reconfigure the product to rapidly respond to unexpected shifts in demand and/or supply shortages (Carbonara & Pellegrino, [2018](#)). Nevertheless, the practice of postponement usually relies on the presence of some basic requirements as a standardized product or modular components (Baud-Lavigne et al., [2012](#)), effective information management (Cavusoglu et al., [2012](#)), and effective inventory policies (Graman, [2010](#)). In addition, the firm requires adequate resources to

obtain the inner resources of a firm (like flexible and adequate capacity) compared to the outer resources (like supplier capacity and materials) needed. In regard to this, suppliers contribute significantly to the practice of postponement in terms of helping to delay product design, production, and purchasing, and dealing with the resulting disruptions (Yang et al., [2007](#)). Hence, it is imperative to develop close relationships with suppliers for ensuring fast and reliable delivery of the materials purchased and enhancing postponement practice (Saghiri & Hill, [2014](#); Trentin & Forza, [2010](#)). Furthermore, firms should comprehend the supplier' choices that can affect the focus on SCR (Rajesh, [2021](#)).

The important role of SR has been increasingly recognized in practicing postponement (Saghiri & Hill, [2014](#)) and improving SCR (Johnson et al., [2013](#); Scholten & Schilder, [2015](#)). SR, which refers to '*a long-term relationship between the firm and its suppliers, which influences the strategic and operational capabilities of individual participating firms to help them achieve significant ongoing benefits*' (Qrunfleh & Tarafdar, [2013](#), p. 573). SR is a resource that appears particularly relevant to the postponement, where a major obstacle in effectively and efficiently implementing postponement is the handling of situations in which established relationships among SC partners are weak (Saghiri & Hill, [2014](#)). However, there is no integrated framework linking SR to the focal firm's postponement practice, which detracts from the benefit of postponement research and practice. Drawing on the resource-based view (Barney, [1991](#); RBV), we argue that firms can benefit from SR not only to lower purchasing costs but on a more comprehensive scale. Therefore, the current study seeks to fill this gap by extending research on how postponement interacts with resources to improve a firm's SCR by arguing that resources (in this case, SR) enhance the effect of postponement on SCR. Therefore, it is posited a second research question:

RQ2: How SR moderates the relationship between postponement and SCR?

However, uncertainties in the dynamic business environment may either enhance the advantages associated with such close-knit collaborations in the long run. Because of this, the literature on SR has identified the importance of understanding the boundary conditions of SR characterized by a superior relationship (e.g. Srinivasan et al., [2011](#)). To deepen the understanding of how postponement interacts with SR, we also examine how environmental uncertainty (EU) relates to the interaction between postponement and SR. We believe, according to transaction cost economics (Williamson, [1975](#); TCE), that the positive effect of SR on the postponement-SCR link may be less in environments characterized by uncertainty. In such environments, firms try to enhance their resilience by decreasing their dependence on interrelationships (Heide & Miner, [1992](#)), as they find it hard to build long-term relationships, which often include complex contracts and inter-commitment (Williamson, [2008](#)). Therefore, it is posited a third research question:

RQ3: How EU influences the moderating effect of SR on the postponement-SCR relationship?

With data obtained – through a questionnaire tool developed from the previous literature – from 261 manufacturing SMEs in Yemen, this study seeks to fill the gaps identified above by focusing on how SMEs use postponement to improve SCR under the contingency of SR and EU.

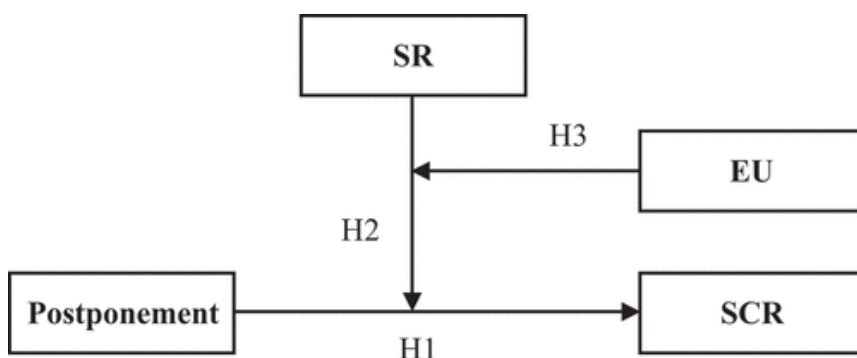
This research has several contributions. First, we examine how postponement affects SCR, which has not received attention in previous studies. Second, we explore how postponement interacts with SR as a relational resource that is required in order to improve SCR. In so doing, we reply to Saghiri and Barnes's (2016) call to clarify which resources foster postponement. Third, we contribute to the literature on relational resources, where Srinivasan et al. (2011) emphasize the importance of determining whether relational resources such as SR directly enhance performance and understanding the boundary conditions of the relational resources. We argue theoretically and examine empirically the interaction of SR with EU to leverage the full potential of postponement, and how EU determines the role of SR. In doing so, we respond to a call of Angkiriwang et al. (2014) to investigate whether there is a relationship between uncertainty and resilience strategies used by firms.

The remaining part of this work is structured as follows: [Section 2](#) discusses the theoretical foundations and the development of hypotheses. [Section 3](#) includes the details of the methods used in this study. [Section 4](#) includes the results of the data analysis and hypothesis testing. [Section 5](#) provides a discussion of the results along with their implications. Finally, [Section 6](#) concludes this study with conclusions and limitations.

## 2. Theoretical background and hypotheses development

Relying on RBV and TCE, we have developed a theoretical model that depicts the links among the main constructs of the study (see, [Figure 1](#)).

Figure 1. Research model.



[Display full size](#)

According to the RBV (Barney, [1991](#)), a firm's resources and abilities are its main sources of competitive edge and superior performance. Grant ([1991](#)) distinguishes between resources and capabilities, stating that resources are the foundation to develop firm capabilities, which are the primary sources of competitive advantage especially in a turbulent market environment (Teece et al., [1997](#)). The resources and capabilities are not limited to the inner assets of the firm but may lie outside the firm's boundaries (Das & Teng, [2000](#); Gölgeci & Kuivalainen, [2020](#)), as the network of relationships between firms may also interpret a firm's competitive edge (Squire et al., [2006](#)). A firm's ability to operate effectively is limited by the resources and capabilities at its disposal, thus it must strive to collaborate with others to benefit from them. It has been proposed that the relationship of a firm to its suppliers may be seen as a strategic resource (Han et al., [2022](#); Madhok & Tallman, [1998](#)). Accordingly, we argue that in order to fully utilize postponement, as an internal operating capability, in improving a firm's resilience to environmental changes, it needs to deploy and integrate external resources and capabilities (in our case, SR) in its SC.

Since SR's effectiveness relies on the environmental dynamics in which the relation parties are integrated (Fynes et al., [2004](#); Srinivasan et al., [2011](#)), we adopt TCE (Williamson, [2008](#)) to explain the effect of EU on exchange relationships. TCE states, assuming finite rationality and opportunism, that transaction costs are incurred as a result of functioning in uncertain environments (Rindfleisch & Heide, [1997](#)). According to Williamson ([2008](#)), parties involved in a relational exchange may abandon cooperative behavior in favor of self-interested pursuits, with the possibility for opportunistic behavior (Poppo et al., [2008](#)). As per TCE, opportunism is mostly induced by uncertainty (Chu et al., [2019](#); Williamson, [2008](#)) which is considered to be one of the significant exchange risks (Cai & Yang, [2008](#)) that is negatively associated with performance (Hara, [2019](#)). It holds that environmental uncertainty accompanying opportunism and bounded rationality can cause information asymmetry, which leads to increasing market transaction costs (Williamson, [1975](#)). Uncertainty complicates an exchange not only by increasing opportunism but also by forcing participants to adapt to unanticipated changes. In summary, the growing opportunism caused by EU reduces dependence on exchange parties and consequently the value of relationship-specific resources in an exchange relationship (Gaur et al., [2011](#)).

## 2.2. SCR

Despite the fact that the contribution of SCR has been the focus of numerous publications, there is still no overarching consensus on its definition (Tukamuhabwa et al., [2015](#)). Numerous definitions of SCR as a positive capability of SCs have been proposed since Christopher and Peck's ([2004](#)) first application of the term resilience to the context of SCM (Ali et al., [2017](#)) due to disparities in the authors' views on SCR (Melnyk et al., [2014](#)). Furthermore, literature reviews by Ali and Gölgeci ([2019](#)) and Kochan and Nowicki ([2018](#)) revealed the issue of an interchangeable terminology of SCR with

the definition of SCR by Ponomarov and Holcomb (2009, p. 131), describing it as 'the adaptive capability of the SC to prepare for unexpected events, responds to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function.' To this end, the adaptive capability of the SC has been developed on the basis of three phases, namely 'readiness', 'responsiveness', and 'recovery' (Sheffi & Rice, 2005), which are included in nearly all definitions. As Briano et al. (2009) argue, resilience entails 'regeneration', where that it is not just about returning to a pre-existing state, but also about returning to a new one.

In today's dynamic business environment, it is essential to build SCR in order to deal with unforeseen risks and disruptions, and to thus continue the firm's operations (Al-Hakimi et al., 2021b; Rajesh et al., 2021). Resilient SCs can anticipate and curtail the negative effects of disruptive events while reducing the time of recovery to normal activity in a meaningful way (Juan et al., 2022; Ruiz-Benitez et al., 2018a; Um & Han, 2020). Firms that are able to deal with SC disruptions are more resilient compared to their competitors (Christopher & Peck, 2004; Scholten et al., 2020) and more able to achieve a competitive edge (Scholten et al., 2020). Related to this, studies show that SCR not only overcomes disruptions in the SC but may also have a direct impact on a firm's performance outcomes (Aslam et al., 2020; Dubey et al., 2021; 2021; Ruiz-Benitez et al., 2018b).

### 2.3. Postponement

The concept of postponement has a long history, not only in terms of its study in the academic literature (Khanra et al., 2021; Yang et al., 2004a; Zinn, 2019) but also in terms of its practical applications as a strategy (e.g. Carbonara & Pellegrino, 2018; Rau et al., 2021; Seth & Panigrahi, 2015; Xiaoxun & Jiajun, 2016). Postponement has been used extensively by several industrial giants, such as Toyota, Motorola, HP (Yang et al., 2004a). The reasons behind its successful use have been of great interest to several researchers (Aviv & Federgruen, 2001; Su et al., 2005; Van Hoek, 1998a, 2001). As it brings many benefits, the most important of which is reducing inventory and improving service because maintaining inventory of an indefinite product requires less safety stock than keeping inventory of many definite products (Davila & Wouters, 2007; Oracle, 2003). The researchers initially concentrated on developing theories about postponement from the perspective of a single firm, but they later expanded to encompass postponement's practice at the SC level (Boone et al., 2007; Chaudhry & Hodge, 2012; Pagh & Cooper, 1998; Yang & Burns, 2003). For this study, postponement is mainly about delaying activities in the SC until genuine knowledge about the markets is available (Yang et al., 2004b), which allows the SC structure to better respond to the changes in customer demand (Rau et al., 2021). Although the practice of postponement is typically discussed in the activities of assembling, packaging, labeling and distribution (Pagh & Cooper, 1998), it may also occur in a wide range of activities including upstream operations in the SC such as

and production postponement involves delaying a wide range of internal decisions (or operations) such as design, development, manufacturing, assembly, packaging or labelling, whereas purchasing and logistics postponement involves delaying external decisions (or operations) within the upstream and downstream SC (Saghiri & Hill, [2014](#)).

A capability to maintain materials undifferentiated till customer orders are received (postponement's basic principle) boosts the capability of SC to respond to customer demand's changes (Lee, [2004](#)). Postponement helps firms to deal with uncertainties (Prataviera et al., [2020](#); Yang et al., [2004a](#)), in that it enables a firm to maintain its options open about how and where a product is designed, produced, or distributed, and thus flexibility in the face of changes in customer demand (Yang et al., [2005](#)). Due to the possibility of re-composition of the product to respond rapidly to unanticipated changes in demand and/or supply shortage, postponement has been cited as a practice in managing disturbances along the entire SC (Angkiriwang et al., [2014](#); Tang, [2006b](#); Yang & Yang, [2010](#)). In this sense, the ability to employ different components when supply disruption or change in product design that makes it appropriate for other clients in the event of a demand disruption makes a firm more resilient to re-compose the product when distinctiveness is desired (Carbonara & Pellegrino, [2018](#)).

Related to this, many studies confirm that postponement enhances a firm's resilience in responding to changes in the market demand (Bandaly & Hassan, [2020](#); Christopher, [2000](#); Seth & Panigrahi, [2015](#)). Xiaoxun and Jiajun ([2016](#)) theoretically argue for the critical role of postponement strategy in reducing SC risk. Indeed, Carbonara and Pellegrino ([2018](#)) claim that firms that adopt postponement can cope more with SC disruptions. Similarly, Rajagopal et al. ([2016](#)) report that postponement is associated with SC responsiveness. Gualandris and Kalchschmidt ([2015](#)) report that postponement represents an effective strategy to mitigate SC disruptions. Additionally, Jafari et al. ([2016](#)) indicate that retailers who adopted postponement are more flexible in their logistics operations. In this vein, Um and Han ([2020](#)) emphasize the importance of postponement strategy for improving SCR and lowering costs by delaying the real commitment of resources. Firms that effectively practice postponement can take advantage of the temporary time to deal with demand fluctuations and to boost SCR (Choi et al., [2012](#); Qrunfleh & Tarafdar, [2013](#); Rajesh, [2017](#)). According to Carbonara and Pellegrino ([2018](#)), postponement is more valuable in riskier situations, where supply and demand disruptions are more likely. However, its value as a strategy to mitigate SC disruption depends on the SC characteristics, notably the upstream and downstream echelons. Avanzi et al. ([2013](#)) demonstrated in their study how the use of implicit postponement options helped Maillefer – a Swiss firm – to build SCR against disruptions induced by economic challenges and to acquire a competitive advantage by creating volatility and then efficiently responding to it. According to the above, we assume that

## 2.4. SR

SR is seen as a key resource and a source to gain a competitive advantage. Drawing on the research work of Qrunfleh and Tarafdar (2013, p. 573), the current study defines SR as *'a long-term relationship between the firm and its suppliers, which influences the strategic and operational capabilities of individual participating firms to help them achieve significant ongoing benefits.'* Relationships between firms and suppliers represent *'valuable bridges, as they give one actor access to the resources of another'* (Harland, 1996, p. 68). According to Lahiri and Kedia (2011), SR brings the firm many benefits including *'customer satisfaction, enhanced perception of fairness and justice, customer loyalty, relationship satisfaction, positive word-of-mouth, repeat transactions and business continuity'* (p. 3). Furthermore, previous studies confirm that a strong SR is linked with mutual sharing of business risks, mutual adaptation, reciprocity, commitment, trust, and the length of the relationship (durability; Lahiri & Kedia, 2011; Srinivasan et al., 2011; Srivastava & Singh, 2013).

Besides, while postponement represents the deliberate delay in the execution of an operation until more information related to the market demand is available (Yeung et al., 2007), the fulfillment of that postponed process requires that all its requirements provided by suppliers are already available. SR may therefore greatly be backing the firm in fulfilling the changing last-minute postponement needs (Saghiri & Hill, 2014) and making the firm more resilient within its SC (Fayezi & Ghaderi, 2021). Further, the close firm-supplier relationship may involve cooperation in the product design or production, thus, it can be said that SR reinforces the successful practice of postponement. Accordingly, more committed suppliers are expected to support changes in the production process of the buyer's firm (Krause, 1999) and invest in the resources and capabilities required to make these changes (Walter, 2003). Similarly, the supplier's commitment in terms of allocating resources to the buyer's demands (Prahinski & Benton, 2004) may be significant support for the adopted firm to postponement strategy in purchasing.

Indeed, Saghiri and Hill (2014) claim that firms that have good relationships with their suppliers usually achieve success through their practice of the postponement strategy. A strong SR enables the firm to respond quickly, helping reduce the longer production lead-time risk that happens in the case of postponement (Kumar & Wilson, 2009), which contributes to enhanced SCR (Chowdhury et al., 2019; Pettit et al., 2013). According to Van Hoek (1998b), SR is essential in determining the changes required to accommodate operations in firms that practice postponement, which enhances a firm's resilience in the face of SC disruptions.

Prior research (e.g. Gao et al., 2005; Gupta & Choudhary, 2016) suggested that cooperation among firms and suppliers and commitment can aid in the sharing of information and reducing uncertainty in the SC network, which contributes to enhanced SCR (Chowdhury et al., 2019). According to Pettit et al. (2013), cooperation reflects a firm's ability to work effectively with SC partners for mutual



by allowing SC partners to help one another during a disruptive event (Jüttner & Maklan, [2011](#)) and to provide a resilient and coordinated response (Tukamuhabwa et al., [2015](#)). Based on the above, it can be assumed that

**H2:** SR positively moderates the relationship between postponement and SCR.

## 2.5. EU

EU refers to 'the rate of change and the degree of instability in the environment (Wang et al., [2011](#), p. 117).' Firms must operate quickly and more efficiently in an uncertain environment (Kwok et al., [2019](#)). Due to the multifaceted uncertainties that firms/managers may confront, we mainly concentrate on the market's EU, which includes severe competition, unanticipated customer requirements, and rapid technological change. In dynamic business environments, which are characterized by the changes in product demand and/or the supply of materials, EU cannot be ignored, as the positive effect of SR on the organizational performance may differ in the different levels of EU (Gaur et al., [2011](#)). The quality of SR relies on the environmental dynamics in which the parties to the relationship are integrated (Fynes et al., [2004](#); Srinivasan et al., [2011](#)). In this regard, two opposing streams of literature are existing on the effect of EU on exchange relationships. One of them assumes that when firms face a high level of uncertainty, they better coordinate their operations as a means of reducing uncertainty (Pfeffer & Salancik, [2015](#)). In contrast, the other argues according to transaction cost economics (TCE) that firms try to enhance their resilience in uncertain environments by decreasing their dependence on interrelationships (Heide & Miner, [1992](#)) as they find it hard to build long-term relationships, which often include complex contracts and inter-commitment (Williamson, [2008](#)).

Despite the ambiguity surrounding the previous research, on the interrelationships between firms, in explaining the positive impact of SR on the firm's performance, the contingency perspective confirms the conditional impact of uncertainty in the firm's relationship with its suppliers (Srinivasan et al., [2011](#)). Some researchers claim that close relationships can have a negative effect on performance (e.g. McEvily et al., [2003](#)), while we argue that the efficacy of the reciprocal relationship of the firm, as a relational resource, may be limited as the EU increases. SR as a relational resource may affect performance in terms of enhancing better knowledge sharing, improving coordination, increasing partner commitment, and lowering transaction costs related to costly monitoring procedures (Krishnan et al., [2006](#)). The benefits of a good relationship, however, may not be realized under a high level of EU. EU exacerbates information asymmetry in the exchange decision process, increases transaction complexity and difficulty, and undermines participants' expected collaboration channels and aims (Yang et al., [2017](#)). As such, it affects the dynamics between partners and their adherence to contractual obligations and contract enforcement, demonstrating that the consequences of contracts on the effectiveness of relationships depend on EU (Aulakh & Gencturk,

Under the high level of the EU, a comprehensive and accurate analysis of the external environment is crucial (Kafetzopoulos et al., [2020](#)). SR may include excessive and frequent dependence on outer information collected by suppliers. Since the partners' ability to process information may be limited by uncertainty, erroneous and incomplete information may result in suboptimal decision-making. In this vein, Kwok et al., ([2019](#)) found that EU decreases the favorable impacts of information exchange on mutual trust and commitment between exchange partners. Similarly, [2020](#) reveal that EU negatively affects the impact of information exchange on performance. EU makes the exchange more difficult not only because it encourages opportunism but also because it forces the parties to adapt to problems brought on by unanticipated developments (Chu et al., [2019](#); Hara, [2019](#)). Therefore, suppliers may, under higher EU level, prefer inaction that would result in their alliance failing to respond to environmental changes (Krishnan et al., [2006](#)). That is, a high level of EU may increase the probability of opportunistic behavior by partners, lowering the value of relationship-specific resources (Gaur et al., [2011](#)). On the contrary, focal firms under a low level of EU (i.e. a more stable environment) may find it easier to make better decisions, as partners can make better judgments on the outer environment, resulting in enhanced SR effectiveness. Accordingly, we assume that

**H3:** Under a low EU, the moderation of SR on the relationship between postponement and SCR will be strengthened.

As evidenced by the literature review presented in the current section, although studies on the precedents of SCR are plenty, the academic literature examines these precedents separately. In particular, so far, the literature has investigated the benefits for firms that practice a postponement strategy, and how this strategy contributes to mitigating disruptions in the SC, to enhance resilience (e.g. Yang & Yang, [2010](#)). Actually, very few studies have focused on the theme of postponement associated with SR. Saghiri and Hill ([2014](#)) addressed this topic and introduced mixed results about the linkage between the ability of the buying firm to delay and SR. These studies, however, do not provide a full understanding of the interactive effect of SR and postponement on SCR. To the best of our knowledge, no study has addressed the role of postponement in building SCR. Also, no study has examined the moderating effect of SR on the postponement–SCR relationship, considering its associated EU conditions. Therefore, our research aims to cover these gaps by studying the relationships in our proposed model.

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## 3. Methods

### 3.1. Sample and data collection

To explore the joint moderation effect of SR and EU on the postponement–SCR relationship, this

questionnaire. Data were gathered from manufacturing SMEs in the Sana'a and Taiz regions, which have the greatest percentage of SMEs in the country across all industries. Despite the dominance of Yemeni SMEs in the manufacturing sector, their contribution to the country's GDP is negligible (Al-Hattami et al., [2021](#); Al-Hattami & Kabra, [2022](#)). An important factor contributing to its poor performance is the SC disruptions caused by the conflict and the country's political crisis, which include stringent inspections at seaports that have restricted imports, delayed raw material arrivals, as well as high insurance and shipping costs (Morris et al., [2019](#); Tandon & Vishwanath, [2020](#)). This is particularly difficult for SMEs, which have fewer resources and must face more concentrated risks than larger firms due to their lower diversity (Al-Swidi et al., [2021](#); Iborra et al., [2020](#); Linnenluecke, [2017](#)), which reflects the importance of SCR for SMEs. Regarding this, there is a dearth of empirical studies relevant to SMEs compared to large enterprises (Brem et al., [2017](#); Didonet & Diaz-Villavicencio, [2020](#); Maldonado-Guzmán et al., [2018](#)), especially in developing countries (Gölgeci & Ponomarov, [2014](#); Scholten & Schilder, [2015](#)), despite the fact that SMEs are critical components of universal SCs and suffer adverse consequences from SC disturbances (Tukamuhabwa et al., [2017](#)).

According to the database from the Yemeni Ministry of Industry and Trade (Yemen Ministry of industry and trade, [2014](#)), there are roughly 2,106 SMEs in Yemeni manufacturing sector. The Yemeni government defines a small-sized enterprise as a firm with four to nine employees, while a medium-sized enterprise is a firm with 10 to 50 employees (Yemen Ministry of industry and trade-YMIT, [2014](#)).

For this study, contact details of SMEs were obtained from the Ministry of Industry and Trade in Yemen. The sample size of 327 SMEs was determined to be a minimum relative to the study population size as recommended by Krejcie & Morgan ([1970](#)). Then, to reduce the sample size error and solve the non-response problem, the sample size was doubled to 654 (Hair et al., [2011](#)). A self-administered questionnaire was used to collect the necessary data from managers/owners of SMEs, who were chosen as the sampling unit for this study due to their familiarity with the enterprise's numerous activities. A total of 654 questionnaires were distributed randomly to managers and owners. Out of 654, 402 were completed and returned, leaving 261 useable questionnaires (a response rate of 40%) after excluding 41 invalid questionnaires. [Table 1](#) indicates the characteristics of the sample.

**Table 1. The characteristics of sample.**

[Download CSV](#) [Display Table](#)



Since the unit of analysis was SME manager/owner and the procedure was based on self-report of

existence of a CMV issue. The findings of the analysis showed that the factor was accounting for 41% of the total variance. In other words, there were no CMV issues in the current model.

## 3.2. Measures

To collect the data necessary for measuring the links in the suggested model, we used the questionnaire tool and a Likert scale with 5-point (1 = Strongly disagree to 5 = Strongly agree) to assess the responses. Drawing on the literature, all the questionnaire measures were developed, as indicated below:

3.2.1 Independent variable (postponement): postponement was measured through six items that adopted and adapted from Khalil et al. (2019) and Li et al. (2005, 2006).

3.2.2 Dependent variable (SCR): SCR was measured in general by six items adopted and adapted from Al-Hakimi and Borade (2020).

3.2.3 Moderating variables (SR and EU): SR was assessed using six items adopted and adapted from Gawankar et al. (2017). Meanwhile, EU was measured using four items adopted and adapted from Wang et al. (2011).

3.2.4 Control variables: we included two control variables (firm size and industry sector) in our analysis in order to control for the differences that might occur due to firm size and industry sector: firm size, operationalized as the logarithmically transformed number of employees; industry sector, operationalized as a dummy variable for the food and beverage, furniture, plastic, packaging, chemical and petrochemical, apparel industries, and a reference category of other industrial sectors (see Appendix A for measurement items of the variables).

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## 4. Analysis and results

### 4.1. Reliability and validity

To validate the study's measures, we conducted the reliability test to measure the internal consistency among scale items. As presented in Table 2, all Cronbach's alpha ( $\alpha$ ) values were above 0.70 (Hair et al., 2011), and all composite reliability (CR) values were over 0.70 (Fornell & Larcker, 1981). In addition, we performed a confirmatory factor analysis (CFA), to test the construct validity, including convergent validity and discriminant validity. All factor loadings were higher than 0.70, and the average variance extracted (AVE) was higher than the commonly accepted cut-off point of 0.50 (Hair et al., 2011), except the construct of postponement whose AVE value was 0.46; however, it shows sufficient convergent validity (Ibid). In general, all constructs are having acceptable

## Table 2. Analysis of convergent validity.



[Download CSV](#) [Display Table](#)

The results in [Table 3](#) show the descriptive statistics of the study variables. Furthermore, the results obtained from the discrimination analysis of latent factors reveal that the discrimination analysis of latent factors shows that the discriminant validity is high since the root-square-values of AVE outweigh the corresponding correlations of all factors (Fornell & Larcker, [1981](#)), demonstrating that the correlation of the indicators with their factors above other factors.

## Table 3. Analysis of discriminant validity.



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## 4.2. Hypothesis testing

To test the hypotheses, we conducted a three-step moderated hierarchical regression analysis using Hayes' Process macro with SPSS, as the main and moderating effects were explored (Hayes, [2018](#)). In the current study, three regression models were established for postponement and SCR. Before the analysis, we performed a variance inflation factor (VIF) test for all variables constituting the interaction conditions to alleviate the multicollinearity threat (Aiken & West, [1991](#)). The highest value for VIF in the current study was 1.566, which is significantly less than the cut-off point of 10 (Hair et al., [2006](#)).

[Table 4](#) illustrates the findings of all regressions from models 1–4. Model 1 displays the regression results with only control variables. The statistical results suggest that none of these control variables had a significant effect on any of the antecedents of SCR in our analysis (see, [Table 4](#)). Model 2 shows the result of the H1 test with respect to the regression of SCR on postponement ( $\beta = 0.35$ ,  $p < 0.01$ ). Thus, H1 is supported. The explanatory power of the model increases when postponement is introduced ( $\Delta R^2 = .11$ ,  $p < .01$ ).

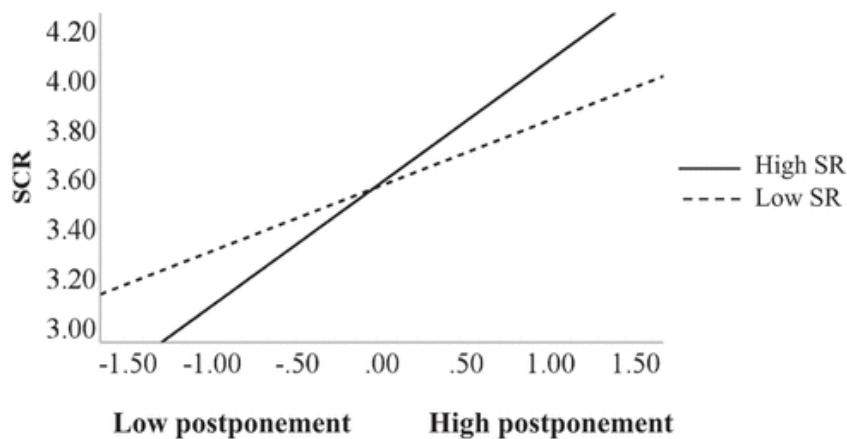
## Table 4. Results of hierarchical regressions with SCR as dependent variables.



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In Models 3 and 4, we entered SR and EU to test H2 and H3. Model 3 displays the result of testing for H2 with respect to the two-way interaction, while Model 4 reflects the result of testing for H3 that shows the three-way interaction. Model 3 in Table 4 shows that the two-way interaction (postponement\*SR) positively moderates the postponement–SCR relationship ( $\beta = 0.12$ ,  $p < 0.05$ ), which provides empirical support for H2. To more clearly perceive the two-way interaction, the interaction effects on SCR, for high and low levels of SR and postponement were plotted according to the procedures suggested by Aiken and West (1991). For example, the graph that represents the relationship between postponement and SCR moderated by SR was constructed by plotting postponement scores one standard deviation (SD) above and below the mean over high (+1.00 SD) and low SR (–1.00 SD). According to Aiken and West (1991), this result indicates that when SR was high (1 SD above the mean), postponement was related more positively to SCR, while when SR was low (1 SD below the mean), postponement was related less positively to SCR. Figure 2 displays the result of the two-way interaction of SR  $\times$  postponement on SCR.

Figure 2. The moderating effect results of SR.



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However, the three-way interaction (postponement  $\times$  SR  $\times$  EU) is described in Model 4. The results denote that the three-way interaction (postponement  $\times$  SR  $\times$  EU) negatively moderates the positive moderating effect of SR on the postponement–SCR relationship; however, this effect is slight ( $\beta = -0.10$ ,  $p < 0.10$ ). Therefore, H3 is supported. In this study, we considered the significance level with '0.10' as a maximum level, as recommended by Hair et al. (1995), which we argue is significant due to the small sample size and the low sample representation.

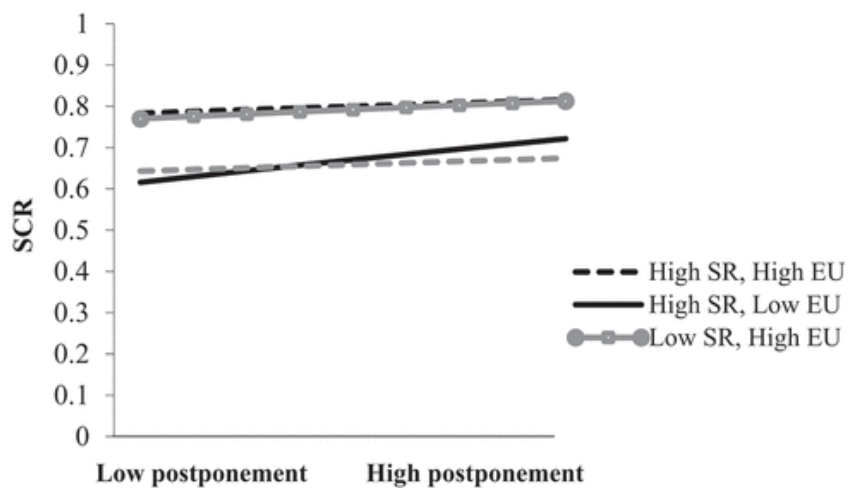
To more clearly perceive the three-way interactions simultaneously, we probed the interaction with simple slope tests of postponement  $\times$  SR interaction at two levels of EU (–1SD and +1SD). According to the results shown in Table 5, at –1SD (i.e. at –1.1293) on the centered EU (representing low EU), the interaction effect of postponement and SR on SCR is positive and significant ( $\beta = 0.1841$ ,  $p = .0521$ ). However, at +1SD (i.e. at +1.1293) on the centered EU (representing high EU), the

Table 5. Test of conditional postponement  $\times$  SR interaction at value(s) of EU.

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In addition, the interaction effects on SCR, for high and low levels of SR, EU, and postponement were plotted (Aiken et al., 1991), using Dawson's (2014) technique, as described in Figure 3. The graph shows the increasing slope for the relationship between SR and postponement with various levels of EU, indicating the importance of postponement for SCR. The graph revealed the importance of SR for SMEs to achieve a high level of SCR when postponement is practiced. The graph also showed that at low postponement practice, SMEs with low levels of SR and EU were the worst SCR. More importantly, the rate of improvement in SCR for SMEs with high SR and low EU was higher with the increase in postponement.

Figure 3. Interaction plot of postponement and SR across EU conditions.



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## 5. Discussion

### 5.1. Major findings

The results show that postponement contributes significantly to building SCR, indicating that the higher the practice of postponement in the SC, the higher its SCR. This is supported by Tang (2006a, 2006b), who cited postponement as a useful tool to mitigate disruptions in the SC. Our findings reveal that the strategic choice of postponement is a key strategy for building a resilient SC. The result is consistent with the prior studies on the topic, indicating that postponement is a valid strategy for dealing with disturbances in customer demand and enhancing firms' resilience towards them. Postponement enables customization and facilitates higher resilience by eliminating the need

boosting SCR in the face of high manufacturing and delivery risk (Um & Han, [2020](#)). By practicing postponement, SMEs can handle more products and accommodate the changes in customer demands for products and fast delivery and hence increase SCRs. Therefore, SMEs that apply a higher degree of postponement are more likely to be more resilient to disruptions in the SC.

Our results also suggest that SR positively moderates the postponement–SCR relationship, indicating that the strength of SR has a synergistic influence on the postponement–SCR relationship. In other words, the effect of postponement on SCR is stronger when SR and postponement are bundled together, that is, the postponement–SCR link is not positive in all cases. This finding aligns with extant research (e.g. Saghir & Hill, [2014](#)) emphasizing the importance of SR to harness the full potential of the postponement strategy. This result in general supports prior studies related to postponement, which indicate that grouping postponement with other compatible SC management practices is likely to boost the resilience of SC (Qrunfle & Tarafdar, [2013](#)). This result is also consistent with RBV and indicates that SR has various levels of effects on operation strategies (i.e. postponement in our case). Our findings specifically reveal that postponement's effect on SCR of SMEs is higher with a high level of SR compared to a low level of SR.

Our work also shows that focusing on a single moderator (SR in our case) while studying the postponement–SCR link may not reflect the degree of the relationship's intricacy. This is because the analysis of individual moderators may be too simplified and may hide more subtle relations. If we concentrated only on the moderating effect of SR, we would have found that SR plays a positive role in the postponement–SCR interaction. Incorporating EU into a three-way interaction, however, yielded more accurate results. Our results reveal that the moderating role of SR on the postponement–SCR link is negatively affected by EU, which indicates that EU inhibits the positive consequences of SR on the postponement–SCR relationship. This suggests that in an environment of significant uncertainty, such as that found in Yemen, suppliers may engage in opportunistic behavior and shirk their responsibilities towards SMEs. More precisely, the effect of SR on the relationship of postponement to SCR is significantly weaker under a high level of EU. This is consistent with the findings of Srinivasan et al. ([2011](#)), which indicate that the positive relationship between SR and SC performance weakens in the presence of significant EU. In addition to the results of Nenavani and Jain ([2021](#)) that showed that the EU negatively moderates the association of strategic supplier partnership with SC response. Our results are also consistent with the findings of Han et al. ([2022](#)), which indicated that the type of communication between buyers and suppliers has different effects on the nature of SR. On the contrary, this result is inconsistent with Rau et al. ([2021](#)) who indicate that operation postponement can improve resilience, even at the substantial risks of demand uncertainty. This result is significant in the literature regarding the effect of EU on exchange relationships, as some scholars made an argument for the negative influence of EU on the positive effect of SR for the focal firm, based on the presumption that firms try to boost their resilience in



[1992](#)). This is because they find it hard to build long-term relationships, which often include complex contracts and inter-commitment (Williamson, [2008](#)). Williamson ([1975](#)) argued that the increase in the EU may create opportunistic behavior of the exchange partners, negatively affecting the company's SCR for not utilizing the full potential of the deferral strategy. This conclusion warns us not to use relational governance unconditionally when EU is high. As a result, our research disproves the premise that the advantages obtained from the firm's reciprocal relationship when a relational resource (in this case SR) is stronger as EU increases.

## 5.2. Theoretical implications

To date, the present research is the first empirical work that investigates the relationship between postponement, SR, and SCR. It is significant to note that all three hypotheses have been validated by the results. The present findings contribute to SCR literature by employing the empirical approach. Following the SCR literature (e.g. Mandal, [2020](#)), we presented a conceptual model assuming that postponement affects SCR under the moderating effects of SR and EU.

This study adds to the existing body of knowledge in many aspects. First, it investigates how postponement affects SCR. Although postponement is recognized as an effective strategy for building resilience by dealing with disruptions along the entire SC (Tang, [2006b](#); Yang & Yang, [2010](#)), it has not received sufficient attention in previous studies. Our study explicitly tests this and provides empirical evidence.

Second, we integrate postponement and SR into an integrated framework. The majority of previous research has examined postponement and SR separately, leading to an incomplete understanding of both. The results obtained show that utilizing the full potential of postponement is supported by SR. It reflects the fundamental benefits of SR in improving SCR through postponement. Our findings generally corroborate the intellectual movement that believes a firm's superior performance can sometimes be attributable to sources of inter-firm advantages (in this case, SR), not to the firm itself (Dyer, [1996](#); Srinivasan et al., [2011](#)). Thus, our study contributes to the current literature on RBV as the findings indicated that investing in relational assets may promote SC integration (Chen et al., [2013](#)) and aid in the development of SCR (Brandon-Jones et al., [2014](#)). Noting this void, Saghiri and Barnes ([2016](#)) called for research to clarify which resources foster postponement. We respond by empirically testing the moderating role of SR on the relationship of postponement to SCR in Yemen. The increased level of cooperation among partners, through better information sharing practices, expands the alternatives for postponements, which in turn enhances SC agility and has a direct influence on the SC's ability to manage stocks (Rajesh, [2017](#)). Accordingly, a weak SR may make the SC vulnerable and affect the firm's practice of postponement and its SCR.

Third, the current study also expands on the literature on relational resources, where Srinivasan et

resources. We argue theoretically and examine empirically the interaction of SR with EU to leverage the full potential of postponement, and how EU determines the role of SR. Noting this void, Angkiriwang et al. (2014) called for research to investigate whether there is a relationship between uncertainty and the resilience strategies implemented by firms. Our results reveal that EU can cause significant disruptions along the SC that may affect the extent to which a focal firm benefit from SR, severely limiting a firm's capability to continue processes, and accurately and timely fulfill customer orders through postponement.

Finally, insignificant findings for firm size and industry controls suggest that the effect of postponement on SCR of SMEs is not related to size and industry. Thence, although industry and firm size clearly may have important implications for firm structure and behavior, they are not likely to have an overt impact on how SMEs use postponement strategy to deal with disruptions and adversities and promote their resilience in difficult times.

### **5.3. Practical implications**

Practically, this study has important implications, as managers of Yemeni SMEs should focus their attention on postponement, which can help Yemeni SMEs to maintain materials undifferentiated till customer orders are received, enhancing their ability to better respond to changes in customer demand, adapt to SC disruptions. In addition, it is important to know moderating factors, such as SR, which can interact with postponement to improve SCR. SR will improve SCR through postponement. Consequently, a firm that wishes to use a postponement strategy in its product design must first acquire the commitment of its suppliers to respond rapidly to last-minute changes in product configuration. Accordingly, Yemeni SMEs should view SR and postponement as synergistic rather than competing strategies. In line with that, managers need to foster trust, cooperation, commitment and collaborative relationships with the suppliers to maximize the effectiveness of postponement in improving SCR.

Furthermore, managers of SMEs should realize that uncertainty may have a detrimental effect on the outcomes of their SR. Thus, they should take appropriate actions to build a steady environment such as proactive environmental scanning, as it may be easier for SMEs to operate and coordinate in such an environment, effectively improving SR quality. As such, the rate of improvement in SCR for SMEs with high SR and low EU is higher as the postponement practice increases, which indicates the importance of SR to utilize the full potential of postponement in a less uncertain environment.

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## **6. Conclusion, limitations, and future research**

This study addresses an understudied phenomenon and provides a new model that offers a better

explores the interactions of SR and EU with postponement on SCR. The results confirm the need to move beyond a focus on direct relations in seeking to understand the conditions that influence how and when postponement affects SCR. By SR, it is expected that SMEs will be able to utilize the full potential of postponement to improve their SCR under a low level of EU.

Similar to any study, this one has some limitations, which in turn require further research. First, this study only examined the moderating effects of SR and EU between postponement and SCR in the context of SMEs in Yemen. Future research, thus, should broadly focus on investigating other variables that may influence that relationship. Second, the scope of the sample was limited to SMEs located in the Sana'a and Taiz regions in Yemen, while future studies can focus on a larger range of enterprises and industries for a better understanding of the links among postponement, SR, EU, and SCR in comparable environments. Finally, the current study relied on cross-sectional data, which precludes causal inference, as there are temporal effects among postponement, SR, SCR, and EU that are not accommodated in this empirical framework. Therefore, future research should be aimed at generating longitudinal data to capture conditional effects.

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## Supplemental material

## The moderating role of supplier relationship on the effect of postponement on supply chain resilience under different levels of environmental uncertainty

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### Supplemental Material

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Supplementary material

Supplemental data for this article can be accessed online at

<https://doi.org/10.1080/21693277.2022.2089264>

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## Appendix A

### Measurement of variables

Table



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