sustainability

Article

How Do Uncertainties Affect Supply-Chain Resilience? The Moderating Role of Information Sharing for Sustainable Supply-Chain Management

Artuğ Eren Coşkun and Ramazan Erturgut *

Department of International Trade and Logistics, Akdeniz University, Antalya 07070, Turkey; erencoskun@akdeniz.edu.tr
* Correspondence: rerturgut@akdeniz.edu.tr

Abstract: Uncertainties caused by many internal and external factors can lead to supply-chain disruptions, increasing the vulnerability and cost of operations. In particular, the COVID-19 pandemic, whose worldwide emergence was not foreseen, has become a major threat to supply-chain resilience and has caused the disruption of global network connections. The purpose of this study is to examine in depth the impact of uncertainty on supply-chain resilience and to determine whether information sharing has a moderating effect on this interaction. The relationships proposed in the research model are tested through empirical analyses in SEM applied to 244 survey data points from internationally operating manufacturing firms in Turkey. The findings reveal several key insights. First, it is concluded that all dimensions of uncertainty, except technological uncertainty, negatively affect supply-chain resilience. Second, although no direct effect of technological uncertainty on supply-chain resilience is found, technological uncertainty has a negative effect on resilience when the moderating role of internal and supplier information sharing is taken into account. Low-level information sharing, as opposed to high-level, creates variation in the severity of supply-chain resilience at different levels of technological uncertainty. In addition, it is worth noting that a high level of information sharing with suppliers under high-uncertainty conditions negatively affects supply-chain resilience. The results of this study, conducted within the framework of the Contingent Resource-Based Theory, demonstrate compatibility with the theory. Based on all the findings, this study suggests that managers should adopt proactive strategies to maintain high supply-chain resilience, considering today's highly uncertain conditions.

Keywords: supply-chain resilience; supply-chain uncertainty; supply-chain information sharing; contingent resource-based theory; SEM

check for updates

Citation: Coşkun, A.E.; Erturgut, R. How Do Uncertainties Affect Supply-Chain Resilience? The Moderating Role of Information Sharing for Sustainable Supply-Chain Management. *Sustainability* **2024**, *16*, 131. https://doi.org/10.3390/su16010131

Academic Editors: Katarzyna Grzybowska, Agnieszka A. Tubis and Piotr Cyplik

Received: 16 November 2023
Revised: 12 December 2023
Accepted: 13 December 2023
Published: 22 December 2023

1. Introduction

Increasingly complex and globalizing supply chains are inevitably exposed to environmental differences that arise at multiple points, and shocking events that occur simultaneously and quickly reflect their effects across the entire chain [1]. Stagnant demand and supply structures have been replaced by fluctuating demand and uncertain environmental conditions. The intangible and tangible resources of businesses, such as labour capacity, employee know how, purchased goods, technical equipment, and financial facilities, have been exposed to significant uncertainties and risks [2]. Natural disasters, terrorism, cyberattacks, credit crashes, and more can cause disturbances in supply chains, and if the risks are not properly managed, damage can occur in areas such as productivity, revenue, competitive advantage, and profitability and even cause serious issues ranging from corporate bankruptcy [3].

Especially in recent years, there have been many events in the world and in Turkey that have had a negative impact on social order, economic conditions, and environmental conditions. Incidents such as Hurricane Harvey in the United States in 2017, the Japanese flood disaster in 2018, and the chip crisis or container crisis have shocked supply chains, putting many industries at a standstill. In addition, two major earthquakes (the first with a magnitude of 7.7 centred in Pazarcık and the second with a magnitude of 7.6 centred in Elbistan), which occurred recently in Kahramanmaraş province in Turkey, created a shock effect in supply chains and logistics operational activities and caused serious disruptions in supply-chain processes.

Apart from external factors, there are also serious uncertainties within the supply chain. In the event of situations directly related to the supply chain, such as a supplier's failure to deliver a good on time, sudden increases or decreases in customer demand, breakdown of one of the most critical machines, low quality of the goods supplied, unpredictability of how much of which product customers will order, and not knowing what level of inventory should be kept, supply chains can experience serious shocks on a global scale with the effect of whiplash or snowball disruptions. Reference [4] suggested that supply-chain resilience (SCRES) offers an alternative way to manage the unique resources to be used in supply-chain networks against all adversities and disruptions [4]. In today's world, where countless economic activities have become interdependent, it is very important to increase resilience in supply-chain operations, considering that a disruption in supply-chain operations will quickly spread to other parts of the market [5].

Strengthening the resilience of the supply chain is the key to minimizing the adverse effects of uncertainty in the supply chain. It has been emphasized that businesses that want to react immediately to disruptions in the supply chain and maintain their competitive position, in other words, aiming to strengthen SCRES, should pay particular attention to collaborative information sharing [6]. Companies also need to have the capabilities to develop sustainable and proactive strategies for developing effective information technologies and strengthening resilience, enabling them to act quickly in the event of any collapse. Since developments in information and communication technologies have led to changes and developments in the sustainable management approaches of supply chains that involve high risks [7].

Based on the preceding, the main purpose of this study is to analyze the impact of supply-chain uncertainties (SCUs) that threaten international businesses regarding SCRES and the role of information sharing on whether there is any difference in the level of this impact. For this purpose, the study is based on the Contingent Resource-Based Theory (CRBT), which combines the Contingency Theory [8–10], suggesting the alignment of organizational resources and capabilities with the variable external factors of enterprises, and the Resource-Based Theory [11], making the information asymmetry arising from the different market conditions of the enterprises a competitive weapon. CRBT emphasizes that implicit and asymmetric information-based resources provide businesses with a competitive advantage and performance, especially in risky and uncertain conditions [12].

Drawing attention to the importance of the concepts of uncertainty, resilience, and information sharing, which have been addressed theoretically in many studies in the literature, systematically bringing together many strategically important issues that businesses consider as cost elements or ignore, and determining the extent to which SCRES is affected by the level of information sharing under different uncertainty conditions using empirical methods are just some of the main motivations for creating the research. In this regard, the conceptual framework has been presented and hypotheses have been developed by determining the relationships between variables (Section 2); the methodology used in the research has been introduced, including demographic characteristics, data collection, and instrument design (Section 3); the validity and reliability tests of the structural model have been performed, and then hypotheses have been tested (Section 4); the contributions of the research findings to theory and practice have been discussed, research limitations have been mentioned and recommendations for future studies are given (Section 5); and finally, a general summary of the findings has been presented (Section 6). By comprehensively examining the impact of uncertainty in supply chains on SCRES and the role of information sharing in this interaction, this research contributes significantly to theoretical development and practice.

2. Conceptual Framework and Hypotheses

2.1. Supply-Chain Uncertainty (SCU)

Uncertainty has emerged as an important concept in many areas, including organizational theory, marketing, and strategic management [13]. Firms operate in constantly changing, complex, and partially unknown environments where actions are often undertaken based on incomplete information [14]. Uncertainty has been defined as "the difference between the amount of information required to perform a task and the amount of information the organization has" [15]. The uncertainties that businesses face in their internal and external environments are among the important reasons for their failures in the industry [16]. Late deliveries, machine damages, order cancellations, and many other disruptions observed on a daily basis cause an increase in the amount of inventory that businesses need to keep. While uncertainties are disturbing and costly for businesses, keeping the right amount of inventory makes it easier to handle raw, semifinished, and finished products [17].

SCU is an important issue that managers seek to address with respect to delivery delays and quality problems caused by the increasing complexity of global supply-chain networks [18]. It is recognized to have a major impact on each stage of the supply chain, spreading throughout the network and leading to inefficient processes and non-value-adding activities [19]. A comprehensive definition of SCU is "decision-making situations in the supply-chain in which the decision-maker does not know definitely what to decide as he (or she) is indistinct about the objectives; lacks information about (or understanding of) the supply-chain or its environment; lacks information processing capacities; is unable to accurately predict the impact of possible control actions on supply-chain behaviour; or, lacks effective control actions (non-controllability)" [20]. Some of the uncertainties in the supply chain arise within a supply-chain member's own organization due to poor material quality or inconsistencies in delivery dates, while others are related to variability in the quality and timing of the materials supplied or the quantities demanded by customers [21].

There are some studies in the literature in which strategies to cope with or mitigate SCU are put forward, and the methods used are systematic literature review [22], content analysis [23,24] or case study [25,26]. In parallel with the methodology of this research, there are many studies that reveal the relationship between SCU and other factors using Structural Equation Modeling (SEM) [27–31]. Reference [27] examined the relationship between environmental and behavioural uncertainties and supply risk-management performance and investigated whether the competence of the risk-management process, monitoring and mitigation of risks, reduces the strength of this relationship. Reference [32] discussed how SCU, which they addressed with demand, quality, and logistics dimensions, affects managers' risk perceptions through the magnitude and probability of disruptions in the supply chain. Reference [28] examined the effects of environmental uncertainties on supply, production, and delivery risks, as well as aimed to identify appropriate types of flexibility that can help reduce supply-chain risk. Reference [29] investigated the effects of SCU on operational processes, information technology, and relational capabilities. Reference [30] tested the effect of SCU consisting of technology uncertainty, testability uncertainty, traceability uncertainty, and product complexity dimensions on quality risk with the moderator variable of supply-chain thinness. Reference [31] examined SCRES with the dimensions of internal uncertainties based on the organization, internal uncertainties based on the supply chain, and environmental uncertainties and investigated the effects of these dimensions on the performance of SME textile enterprises in Indonesia. As a result of the literature review, no article was found in which the effects of SCU on SCRES were investigated in detail, and the role of information sharing among supply-chain actors in this interaction was examined. In addition, uncertainties in the supply chain are analyzed for the first time in this study under five dimensions: supplier, internal, customer side, technological, and environmental uncertainties.

2.2. Supply-Chain Resilience

Resilience is defined as “a system’s ability to return to a new stable situation after an accidental event”. The “accidental event” in the definition of resilience refers to an event that causes a systemic deterioration or a visible accident [33]. Reference [34] defined resilience as “the characterization of an organization’s ability to react to an unexpected disruption, such as one caused by a terrorist attack or a natural disaster, and restore normal operations” [34]. Resilience determines the permanence of relationships within a system and is a measure of the ability of these systems to absorb changes in their constant and continuous parameters and ensure continuity in operations [35]. Reference [36] stated that it may not be efficient to consider the underlying causes of disruption in a production system or a supply-chain network, in other words, to focus on resilience through an event that occurs as a result of random or malicious actions that may cause disruption. Instead, he claimed that the focus should be on the damage to the system/network and how the system/network can be restored quickly [36]. Stating that it is not realistic to expect the supply chain to return to its original state under shocks that cause various disruptions due to the complexity and variability of the external environment, reference [37] argued that resilience can be measured in two different ways: the time required to reach a normal state and the gap between the normal state and the original state [37].

In the era of the industrial revolution, the creation of security stocks as the main method of separating production from demand and combating countless uncertainties throughout the system is an example of the first applications of SCRES [38]. Forrester’s studies published in 1958 and 1961, which examined the bullwhip effect, one of the structural problems of the supply chain, on-demand risks, and how they can cause disruptions along the supply chain, constitute the origin of SCRES in the literature [39]. The first large-scale research on SCRES was conducted in the UK in 2000 following transport disruptions caused by fuel protests [38]. However, the conceptual examination of SCRES gained momentum with the publication of [36,40].

SCRES is a topic that is frequently researched in the field of supply-chain management and has not yet reached saturation, especially after recent events such as the container crisis and the chip crisis, which have suddenly arisen and caused disruptions in the supply chain. There are many studies using qualitative research design to understand the risks in the supply chain and to determine the effects of resilience on the supply chains of various sectors or socioecological systems [1,41–44]. In addition, studies examining the relationship between SCRES and other parameters in the supply chain using SEM as a method have an important role in the literature and are frequently included [45–50]. Reference [45] identified 13 components for SCRES practices, defined each component and tested the relationship between them with empirical methods. Reference [46] investigated the effects of supply-chain lower level capabilities consisting of external, integration, and flexibility capabilities on resilience, which refers to the operational capability of the supply chain. Reference [47] analyzed the data obtained as a result of in-depth interviews with supply-chain managers and created a pool of dimensions and subdimensions of the SCRES scale. Then, the effects of SCRES on supply-chain performance were tested using SEM. Reference [48] investigated how Industry 4.0 affects supply-chain performance and whether SCRES mediates this effect. Reference [49] examined how the elements that make up SCRES affect disruption orientation, which refers to the ability to accumulate and participate in learning about how to manage disruptions in the supply chain [49], and whether SCRES mediates this effect. Reference [50] aimed to reveal how digital-oriented business capability and supply-chain governance contribute to SCRES.

2.3. Supply-Chain Information Sharing (SCIS)

Information sharing refers to the distribution of useful information between individuals, organizations, and systems [51]. It includes real-time, two-way data exchange about different aspects of operations management, such as inventory level, order status, and delivery schedules, as well as forecasts and plans for supply-chain partners. Since it is difficult for businesses to access all the resources they need, they have to interact with the businesses that hold these critical resources in order to gain a superior position over their competitors [52]. For this reason, businesses striving to achieve their goals by getting rid of competitive pressure invest heavily in enterprise resource planning (ERP), corporate intranet, information portals, and other communication-based information-technology applications [53]. Information sharing helps businesses to collaborate with each other in activities such as sales, production and logistics by allowing information in the supply chain to be distributed among stakeholders and data to be accessible [51]. If implemented correctly, businesses are able to predict market demand and make better production, capacity, and inventory planning decisions as the probability of sharing incorrect or incomplete information will decrease [54].

The increase in the number of studies addressing information sharing from the supply-chain dimension, especially after the millennium, is an indication that the issue has started to be valued recently. Related studies have generally evaluated the issue through the whiplash effect [55–57]. After understanding the importance of information sharing in the supply chain, the subject has been frequently examined in the literature from different aspects. Qualitative studies [58,59], mathematical modelling studies [60–63], simulation models and papers using game theory [64–66], and studies that measure the relationships between concepts with SEM [67–69] contribute to the intellectual development of the field. Using SEM, [70] investigate the impact of managerial ties and trust dimensions on information sharing and supplier opportunism in the supply chain. Reference [68] researches the effect of the information that manufacturers in two- or three-stage supply chains share backwards with their suppliers on the responsiveness of suppliers and manufacturers and the indirect effect of the information shared by customers with manufacturers on the responsiveness of the supplier. Reference [69] examines how information sharing affects supply-chain agility under different dependency relationships with suppliers or customers.

2.4. Theoretical Background and Hypotheses Development

2.4.1. Contingency Theory

Organization theorists have emphasized that organizations need to adapt to their environment in order to survive, and, therefore, the role of uncertainty in organizational structure is a very important issue in organization theory [16]. Along with the Contingency Theory (CT), where the view that there is no single good way to cope with challenges is put forward, SCU has continued to be a frequently addressed issue in the literature since the 1960s [8,71]. Reference [71] is one of the first sources to explicitly and systematically interpret the concept of uncertainty by taking into account the recommendations of CT. Reference [8], extending the scope of [71], suggested that uncertainties consist of three elements: unclear information, uncertainties in causal relationships, and uncertainty in the time interval of feedback. According to the CT, enterprises can decide which information to share or not to share with other participants in the supply chain according to whether customer needs are met or the level of risk of wasting organizational resources; in other words, whether the conditions are favourable [72]. On the other hand, it has been stated that the CT can help to keep the errors that are likely to occur in the implementation of the prepared strategic plans at a low level and allow businesses to quickly adapt their strategies to reduce disruptions in the supply chain [73].

2.4.2. Resource-Based Theory

Resource-Based Theory (RBT) is another theory associated with uncertainty, information sharing, and resilience in the supply chain in this study. The need to gain an advantage in an intensely competitive environment by performing supply-chain processes and logistics activities with high performance has led many logistics-themed studies in the literature to be associated with RBT [74–77]. Asserting that firm-specific resources are heterogeneous [78], the theory discusses how firms should manage their resources and capabilities to achieve sustainable competitive advantage [79,80]. Emphasizing that even enterprises in the same sector should have different resource and capability diversities, the theory is discussed in the context of developing unique strategies to manage and mitigate risks and uncertainties in the supply chain [81].

In order to achieve resilience by minimizing the negative effects of supply-chain disruptions, intangible resources prioritized in the RBT are vital [82]. It has been stated that the impact of disruptions can be reduced with strategies created through these resources, which are also called business-specific capabilities, before or after the disruptions occur. The more time it takes to implement the relevant mitigation strategies, the easier it will be for the deterioration to spread, the decrease in performance will occur, and businesses will have difficulty in building resilience [73]. According to the RBT, information sharing is so important in these strategies, and it argues that the private information of the enterprises should not be shared. Thus, the enterprises can make themselves more advantageous than their competitors [72]. In this context, RBT is widely accepted as one of the most prominent and powerful theories to define, explain, and predict organizational relationships [83]. The theory suggests that organizations should not only discuss their internal resources but also build relationships with their stakeholders by sharing information with them [84].

2.4.3. Contingent Resource-Based Theory

Despite its prevalence in the existing literature, RBT has been criticized for its inability to identify the conditions under which resources or capabilities may be most valuable [85]. CT, on the other hand, suggests that organizations need to adapt depending on the environmental conditions in which they operate [86]. There are various studies in the supply-chain-management literature in which the Contingent Resource-Based Theory (CRBT) is proposed because it links the static nature of the RBT to adaptive conditions [47,49,87]. CRBT strengthens the ability of enterprises to make sense of information, increases capabilities based on information sharing, cooperation, and coordination, and, above all, provides a competitive advantage to firms. It also increases resource alignment among businesses in the supply chain and enables the emergence of continuously evolving and nonrepetitive strategies [88]. CRBT also helps us to understand how and when organizations can achieve SCRES and robustness [87]. This is because the CRBT argues that, in the building of resilience capabilities, not only the intangible and rare resources over which businesses have control but also the conditions that are embedded in the supply chain are effective [89]. Considering the conditions in which supply-chain disruptions are observed, CRBT motivates businesses to create resources to increase the impact of SCRES enhancers and reduce the impact of inhibitors [90].

2.4.4. The Impact of SCU on SCRES

SCU covers the disruptions that have occurred or are likely to occur in the supply chain, and the value and benefits of the existing resources of the business to achieve capabilities that can help recover from the disruptions [91]. Recently, the Coronavirus (COVID-19) pandemic, which no one could have predicted and affected the whole world, caused serious disruptions in supply chains, and the importance of SCRES in managing the alignment between customer demand and supplier capacity has been emphasized more frequently [4]. Although resilient supply chains are not the most cost effective, they provide businesses with various capabilities to cope with the uncertain business environment and to reveal the areas where the supply chain is most vulnerable [92]. Although steps such as adopting just-in-time and lean production methods and cooperating with a small number of suppliers in order to reduce costs are attractive for businesses, it is thought that such practices will leave businesses vulnerable to uncertainties and consequently reduce SCRES [93]. For this reason, the following hypothesis was developed.

H1: *SCU has a negative impact on SCRES.*

Uncertainties in the supply chain are analyzed in this study with the dimensions of supply, internal, customer-side, technological, and environmental uncertainties. Failure to manage supply uncertainties well causes various disruptions in operational processes and businesses fail to meet customer demands effectively [94]. It has been argued that supply uncertainties reduce the impact of an organization's innovative efforts and pose a major threat to SCRES [95]. Therefore, we propose the following hypothesis.

H2: *Supply uncertainty has a negative impact on the SCRES.*

Internal uncertainty, which rarely affects the continuity of the supply chain and arises from unforeseen events, causes large-scale disruptions in the supply chain [96]. Stockouts, quality problems, production fluctuations, or order cancellations are examples of internal uncertainty [97]. These events, which prevent the continuity of operations and rapid recovery of the supply chain during disruptions, also damage the resilience of supply chains [96]. Effective operational processes designed to cope with uncertainty and effective management strategies contribute to the performance and competitiveness of firms and their resilience [31]. In this context, hypothesis H3 is proposed.

H3: *Internal uncertainty has a negative impact on the SCRES.*

In supply chains where customer expectations are high, an increase in lead-time uncertainty reduces resilience. It has been concluded that a 25% and 50% increase in lead time decreases resilience performance by 69% and 176%, respectively [98]. For this reason, it is highlighted that more emphasis should be placed on increasing resilience and collaborative action during this period when demand uncertainty has a serious impact [99]. Therefore, hypothesis H4 is proposed.

H4: *Customer-side uncertainty has a negative impact on the SCRES.*

Uncertainties in information and communication technologies, such as machine breakdowns, the costs of which are very difficult to predict in advance, have the potential to make supply chains vulnerable [100]. The inability of businesses to fully understand the technological environment or to predict the direction of technological developments creates a sense of technological uncertainty among decision makers. In particular, the use of new technologies by competitors is a source of uncertainty for businesses and an important source of disruption that undermines resilience [101]. Therefore, the following hypothesis, H5, is formulated.

H5: *Technological uncertainty has a negative impact on SCRES.*

Environmental events, such as natural disasters, terrorist attacks, financial crises, government elections, or regime change, cause disruptions in the supply chain, and this situation increases environmental uncertainties [82]. Businesses located in geographies with high environmental uncertainty may engage in opportunistic behaviours and avoid their responsibilities towards their stakeholders. It is very critical to invest in SCRES in order to minimize the negative effects of the related problem [102]. Reference [103], arguing that environmental uncertainties are often irreducible, stated that accessing resilience in supply chains with an appropriate structure enables rapid and proactive responses. Reference [47] emphasized that the relational ties between supply-chain members increase the environmental adaptation skills of enterprises in order to achieve the goals and performance targets set in the supply chain, thus reducing environmental uncertainties and improving their resilience capacity. Based on the above information, the following hypothesis, H6, is proposed.

H6: *Environmental uncertainty has a negative impact on the SCRES.*

2.4.5. Moderating Effect of SCIS

Businesses are constantly striving to identify and cope with uncertainties due to the lack of information in both their internal and external environments [104]. Information sharing has been recognized as an important premise in reducing uncertainties and making SCRES [105]. Since information sharing helps to reduce uncertainty in internal and external environments by capturing dynamics, especially in supply chains with standardised processes [106]. Reference [107] investigated whether a low or high level of information sharing causes a change in the level of customer-side, supplier, and technological uncertainty and concluded that the effects of the related types of uncertainty are low in organizations with high information sharing. Reference [47] claimed that information sharing contributes to increasing SCRES by reducing uncertainties in the supply-chain network with the help of trust, cooperation, and commitment. Therefore, the following hypothesis, H7, is proposed.

H7: *SCIS has a moderating effect on the relationship between SCU and SCRES.*

Since the decisions for the tasks carried out in processes dominated by uncertainty are made as a result of much more information sharing, this situation leads to more changes in working plans [15]. Reference [108] stated that uncertainty, which fundamentally threatens the functioning of organizations, cannot be prevented by risk-assessment studies, better planning, or information sharing. Also, uncertainties should not be ignored in strategies developed on resilience and should be integrated with the perception of resilience. Therefore, hypothesis H8 is proposed.

H8: *Internal information sharing has a moderating effect on the relationship between SCU and SCRES.*

Sharing the risks undertaken and the difficulties experienced in terms of resources through cooperation with suppliers is very important in terms of developing resilience [31]. It has been stated that internal uncertainty can be reduced by establishing an appropriate and proactive relationship with a supplier, such as by sharing information, developing relationships, and conducting joint reviews [103]. Reference [109] suggested that, when faced with supply-chain-disruption risks, manufacturers should closely follow new information technologies and use effective interfaces to share demand information from customers with suppliers in order to increase their SCRES. Reference [110] argued that internal information sharing contributes to supply-chain sustainability and firm performance by reducing risks in the supply chain. Therefore, the following hypothesis H9 is proposed.

H9: *Information sharing with suppliers has a moderating effect on the relationship between SCU and SCRES.*

High customer expectations, intense competition, and dynamic market demand are factors that increase supply-chain uncertainty [111]. Businesses that share information with customers improve their ability to detect fluctuations in the supplier's demand process [112]. It has also been stated that information sharing with customers provides a complete picture of product markets and reduces downstream uncertainty [113]. Based on these considerations, the following hypothesis, H10, is proposed.

H10: *Information sharing with customers has a moderating effect on the relationship between SCU and SCRES.*

3. Research Methodology

3.1. Sample and Data Collection

The population of the research is the enterprises engaged in foreign-trade activities in the Antalya province of Turkey. The reason for the selection of Antalya is that it is one of the largest foreign-trade centers in Turkey. It has enterprises engaged in production in almost all sectors, especially in agriculture, food, and mining. It has a free zone. It has become one of the points of attraction in foreign trade due to the effective use of sea- and airports and its recognition in tourism. The sample of the research consists of lower, middle, and upper-level managers who work in purchasing, sales, procurement, supply, supply contract, logistics, planning, foreign trade, export, import, etc., departments of companies that are engaged in industrial production and foreign trade activities in Antalya and who have a good command of the interaction with stakeholders and the supply-chain processes of the company they work for.

In order to determine the population of the research, lists were created by gathering the information of the companies on the websites of the Antalya Organized Industrial Zone (AOSB) and the Antalya Free Zone (ASBAS). In the created list, 283 companies from AOSB and 79 companies from ASBAS were included. As a result of the examination of the websites of the enterprises, it was found that approximately 82% of the enterprises in AOSB, 232 of them, are engaged in foreign trade activities. It is assumed that all the enterprises operating in ASBAS are engaged in foreign-trade activities. In this case, the total number of enterprises suitable for the research population was determined to be 311. With a confidence interval of 95% and a margin of error of 5%, the sample adequacy is 169 for a main population of 300 and 175 for a main population of 320 [114,115]. Using the snowball sampling method, a total of 251 participants were interviewed as part of the research, 212 of whom were interviewed during business visits and 39 of whom were interviewed online. This is more than 40% of the sample size reported in the literature. This allows for a more comprehensive and accurate representation of the target population (Table 1).

Table 1. Demographic characteristics of the participants.

Characteristics	Category	Frequency	%
Gender	Female	78	32.8
	Male	160	67.2
Age	21–30	63	26
	31–40	86	35.5
	41–50	62	25.6
	51–60	28	11.6
	>61	3	1.2
Education	High School	6	2.5
	Associate	32	13.1
	Undergraduate	169	69.3
	Graduate	35	14.3
Seniority	<1	36	14.8
	1–3	53	21.8
	3–7	66	27.2
	>7	88	36.2
Age of the Company	<10	35	14.3
	10–40	162	66.4
	>40	46	18.9
Number of Employees	<50	63	25.8
	51–100	22	9
	101–200	21	8.6
	201–500	54	22.1
	501–1000	36	14.8
	>1000	48	19.7

3.2. Instrument Design

All items in the survey, which consists of five-point Likert questions, were adapted from other studies. The internal, customer-side, and environmental uncertainty dimensions of the SCU scale were adapted from [67,116], the fourth item of the supply and technological uncertainty dimension was adapted from [13], and the first three items of the technological uncertainty dimension were adapted from [117]. Although supply, demand, and technological uncertainties, which are the subdimensions of SCU in the literature, are generally analyzed under environmental uncertainties, in this study, environmental uncertainties are separated from the related dimensions and handled in a general framework that includes issues such as weather, strikes, traffic congestion, regulatory requirements, the cyclical situation of the country, and exchange-rate fluctuations. In this respect, the SCU Scale was analyzed for the first time in this study under the dimensions of internal, customer, supply, technological, and environmental uncertainties. The information-sharing effectiveness scale was adapted from [118] and the SCRES scale was adapted from [119]. A five-point Likert scale (one = strongly disagree, two = disagree, three = neither disagree nor agree, four = agree, five = strongly agree) was used for all variables in the survey form. As the original versions of the relevant scales were in English, the items were translated into Turkish. Then, all items were adapted taking into account the responsiveness of managers in manufacturing companies. Pretests were conducted to check the content validity, and the questionnaire was finalized.

The research model and the items of the scales used in the quantitative analysis took into account the features suggested by the CRBT to ensure theoretical consistency. The creation of a comprehensive five-dimensional scale in SCU is quite compatible with CRBT in terms of determining how SCRES will be affected under which conditions. In addition, since information is emphasized as the most fundamental intangible capability that distinguishes businesses from their competitors in CRBT, determining the extent to which shared information will protect businesses from turbulence under various conditions reflects the compatibility of the established methodology with the theory. As CRBT suggests what resources can be used to mitigate the negative impact of supply-chain disruptions, considering SCIS with three different dimensions in the model helps identify the relevant resources.

In order to ensure the validity of the content, a detailed literature review was carried out, and the questionnaire form was presented to eight people, four of whom were academic experts and four of whom were sector representatives. Corrections were made by the participants according to the criticisms received in order to increase the comprehensibility of the questionnaire. Following the adaptation of the questionnaire, a face-to-face questionnaire was administered to 16 sector representatives to retest the suitability of the statements for the target audience. It was found that there was no criticism of the questionnaire statements, and a complete return was received. A hypothetical model was developed that SCIS has a moderating effect on the impact of SCU on SCRES, in line with the hypotheses put forward and explained in relation to the literature. The research model is illustrated in Figure 1.

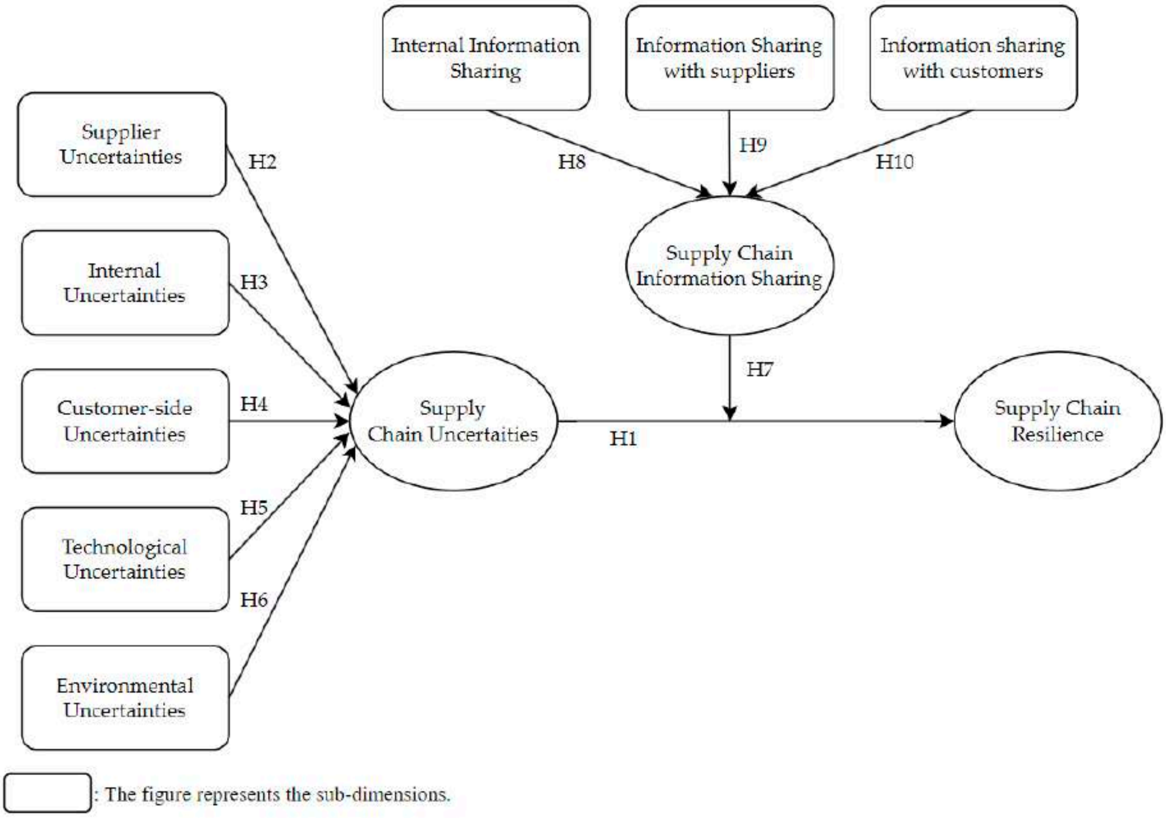

Figure 1. Research Model.

4. Results

4.1. Validity and Reliability Check

Firstly, common-method bias was examined in the validity tests. Common-method bias refers to the fact that due to conditions such as the order of the items in the scale, the place and time of application, and the content of the training given to the participants, the participants may have a bias in their scoring, and this situation affects the collected data [120]. For this purpose, Harman's single-factor test was first carried out. According to the analysis, the total variance of a single factor should be less than 50%. In this study, 17.5% was found. In other words, according to this test, there is no common-method bias.

Another method to determine whether there is common-method bias is the analysis of common-method variance. The difference between the standardised regression weights of the common latent variable of all variables and the standardised regression weights of the model without the common latent factor is examined. This difference should be less than 0.2 to avoid common-method bias [121,122]. According to the results of the common-method analysis of variance performed on the variables, the differences between the standardised regression coefficients of the model with and without the latent factor were examined and all values were found to be less than 0.2. In other words, according to this analysis, no variable is affected by common-method bias.

After the common-method bias control, an exploratory factor analysis (EFA) was conducted. Factor analyses were performed with the varimax rotation technique. The first condition of factor analysis is factor loadings, and factor analysis is not appropriate for constructs that do not have factor loadings above 0.33 [123]. Since only the SCRES6 item had a factor loading of 0.312, the relevant item was excluded from the analysis. One of the indicators to be considered in factor analysis is the eigenvalue. Only factors with eigenvalues of one or greater are considered significant [123]. Then, the p significance value of Bartlett's test of sphericity should be checked and the relevant value should be less than 0.05 [124]. In factor analysis, whether there is multicollinearity between variables, i.e., sampling adequacy, is tested with Kaiser–Meyer–Olkin (KMO) statistic. The KMO value should be at least 0.6 [125]. In research on social sciences, it is stated that a solution that explains 60% of the total variance (slightly less can be accepted) is satisfactory [124]. All variables fulfil the conditions described above.

After exploratory factor analysis (EFA), a confirmatory factor analysis (CFA), which is one of the foundations of structural equation modelling, was carried out. The CFA reveals the relationship between observed indicators and latent variables. The CFA reveals how well the pretested factor structure is measured [126]. Reference [124] states that the lower limit of the standardised factor loading depends on the number of samples, suggesting that the factor loading should be at least 0.40 in a dataset with 200 samples and at least 0.35 in a dataset with 250 samples. In the CFA, the goodness-of-fit indices were then checked to determine how appropriate they were for the data set. The fit indices of the measurement model of this study are generally acceptable. Data for the measurement model, including EFA and CFA factor loadings, are presented in Table 2.

Table 2. Measurement Model.

Construct	Mean	SD	Factor Loads (EFA)	Standardized Loads (CFA)	VIF	Cronbach Alpha	Skewness	Kurtosis
SCU-I	1.579	0.556	0.841–0.505	0.825–0.656	1.046	0.740	0.668	−0.248
SCU-CS	2.365	0.874	0.788–0.652	0.915–0.490	1.104	0.720	0.354	−0.588
SCU-TECH	3.737	0.983	0.857–0.615	0.918–0.555	1.069	0.748	−0.705	−0.065
SCU-ENV	2.417	0.788	0.729–0.576	0.712–0.457	1.052	0.769	0.662	0.089
ISI	3.862	0.887	0.898–0.753	0.882–0.700	1.147	0.877	−0.718	0.070
ISS	3.397	0.971	0.888–0.582	0.910–0.603	1.116	0.877	−0.667	0.083
SCRES	3.823	0.730	0.863–0.731	0.819–0.620		0.880	−0.549	−0.037

X2/SD = 2.007 ($p < 0.05$), **CFI** = 0.891, **PGFI** = 0.670, **NFI** = 0.808, **IFI** = 0.893, **RMSEA** = 0.064, **SRMR** = 0.073.

Average variance extracted (AVE) values were calculated to test the convergent validity. The magnitude of the correlations between the variables should be greater than 0.5 to ensure convergent validity. The fit and discriminant validity data of the research model are presented in Table 3. Since the factor loadings of SCU-I4 and SCU-I5 items in the internal uncertainty were relatively low (0.426 and 0.362, respectively), these statements were excluded from the analysis. After the two related items were removed from the analysis, internal uncertainty remained in three items, and, thus, the AVE value of the dimension increased to 0.518 and the structure was preserved. Then, the SCU-CS1 item of the customer-side uncertainty with a factor load of 0.454 was removed from the data set. After this process, the number of items belonging to the dimension decreased to three, and the AVE value increased to 0.507. Finally, although the expression SCU-TECH3 belonging to the technological uncertainty dimension had a factor loading of 0.514, it was excluded from the analysis in order to prevent the AVE value from falling below 0.5 and having the lowest factor loading in the dimension. So, the AVE value of technological uncertainty increased to 0.55.

Table 3. Convergent and discriminant validity findings of the research model.

Structure	AVE	Square Root of AVE	CR	SCU-I	SCU-CS	SCU-TECH	SCU-ENV	ISI	ISS
(1) SCU-I	0.518	0.720	0.745						
(2) SCU-CS	0.507	0.711	0.761	0.045 (0.101)					
(3) SCU-TECH	0.545	0.738	0.768	−0.048 (0.109)	0.168 ** (0.288)				
(4) SCU-ENV	0.364	0.603	0.770	0.036 (0.081)	0.204 ** (0.297)	0.035 (0.220)			
(5) ISI	0.649	0.806	0.881	−0.188 **	−0.018	0.182 **	−0.048		
(6) ISS	0.574	0.758	0.890	−0.124	−0.158 *	−0.014	0.023	0.263 ** (0.324)	
(7) SCRES	0.550	0.742	0.879	−0.227 **	−0.134 *	0.035	−0.123	0.667 **	0.334 **

Note 1: In two-tailed correlation analysis; ** $p < 0.001$ and * $p < 0.05$ denotes significance levels. **Note 2:** Values in parentheses show the heterotrait–monotrait (HTMT) values to assess discriminant validity.

The only variable in the data set where the AVE value was below 0.5 was environmental uncertainty. Even if the SCU-ENV2, SCU-ENV4, and SCU-ENV5 items with the lowest factor loadings in the related variable were removed, the AVE value could not exceed the 0.5 threshold. The environmental uncertainty dimension passed the explanatory factor analysis, reliability analysis, normality test, composite reliability value, and discriminant validity tests without any problem. In addition, [127] stated that, although the AVE value was found to be lower than 0.5, if the composite reliability (CR) was above 0.6, the concurrent validity of the related construct could be accepted. The composite reliability of the SCU-ENV dimension is 0.770. For this reason, the SCU-ENV dimension was retained and not removed from the model. The SCIS and SCRES variables fulfilled the conditions of convergent validity.

A composite reliability (CR) calculation was performed on the data set due to convergent validity. Composite reliability represents an index reflecting the effect of error margins on the scale. A high composite reliability is one of the necessary conditions for validity [128]. The CR value is expected to be greater than 0.6. The CR coefficients of all constructs in the data set are greater than 0.7. Thus, the composite reliability condition of the data set was achieved. In general, since the AVE and CR coefficients are above the thresholds specified in the literature, it can be concluded that the data set provides convergent validity.

Following convergent validity, the discriminant validity of the construct was tested. If the correlation between a set of variables assumed to measure different constructs is not very high, this is an indicator of discriminant validity [121]. For discriminant validity, the Fornell–Larcker criterion and the heterotrait–monotrait ratio (HTMT) were examined. According to the Fornell and Larcker criterion, the square root of the AVE of the dimension is expected to be greater than the correlation coefficients between the dimension and other dimensions in order to mention discriminant validity [127]. Reference [129] stressed that the HTMT ratio should be less than 0.85 to ensure discriminant validity. As can be seen from the results of the validity analysis in Table 3, the construct provides discriminant validity.

4.2. Assessment of the Structural Model

Following the explanatory and confirmatory factor analyses, the final research model was tested using a path analysis. Path analysis is based on estimating the strength of path diagrams using simple bivariate correlations to estimate relationships in a SEM [124]. First, the effect of the independent variable SCU on the dependent variable SCRES was analyzed. As the hypotheses are tested with a 95% confidence interval, hypotheses with a significance value greater than 0.05 are not significant. The strength and direction of the effect between variables were determined by standardised regression coefficients. The chi-square value, which indicates both the theoretical and managerial suitability of the model, was found to be 52% in the structural equation model established in this study. It is suggested that the chi-square value of an ideal SEM should be above 50% [130]. The final version of the research model and the results of the path analysis are presented in Figure 2.

Since the supply uncertainty and information sharing with customers dimensions in the first model were removed, they are not included in the final model. Therefore, hypotheses H2, "Supply uncertainty has a negative impact on the SCRES.", and H10, "Information sharing with customers has a moderating effect on the relationship of SCU and SCRES", could not be tested. In addition to the main hypothesis of the study, H1 ($\beta = -0.169$, $p < 0.01$), the results of direct impact analyses have also accepted the hypotheses of H3 ($\beta = -0.216$, $p < 0.001$), H4 ($\beta = -0.134$, $p < 0.05$) and H6 ($\beta = -0.096$, $p < 0.05$). Among the hypotheses measuring the level of direct effect, only hypothesis H5 ($\beta = 0.035$, $p > 0.05$) was rejected. The CRBT is consistent with the hypothesized results of this study in that it suggests that variable conditions have a significant effect on the level of SCRES. The results of the SEM are presented in Table 4.

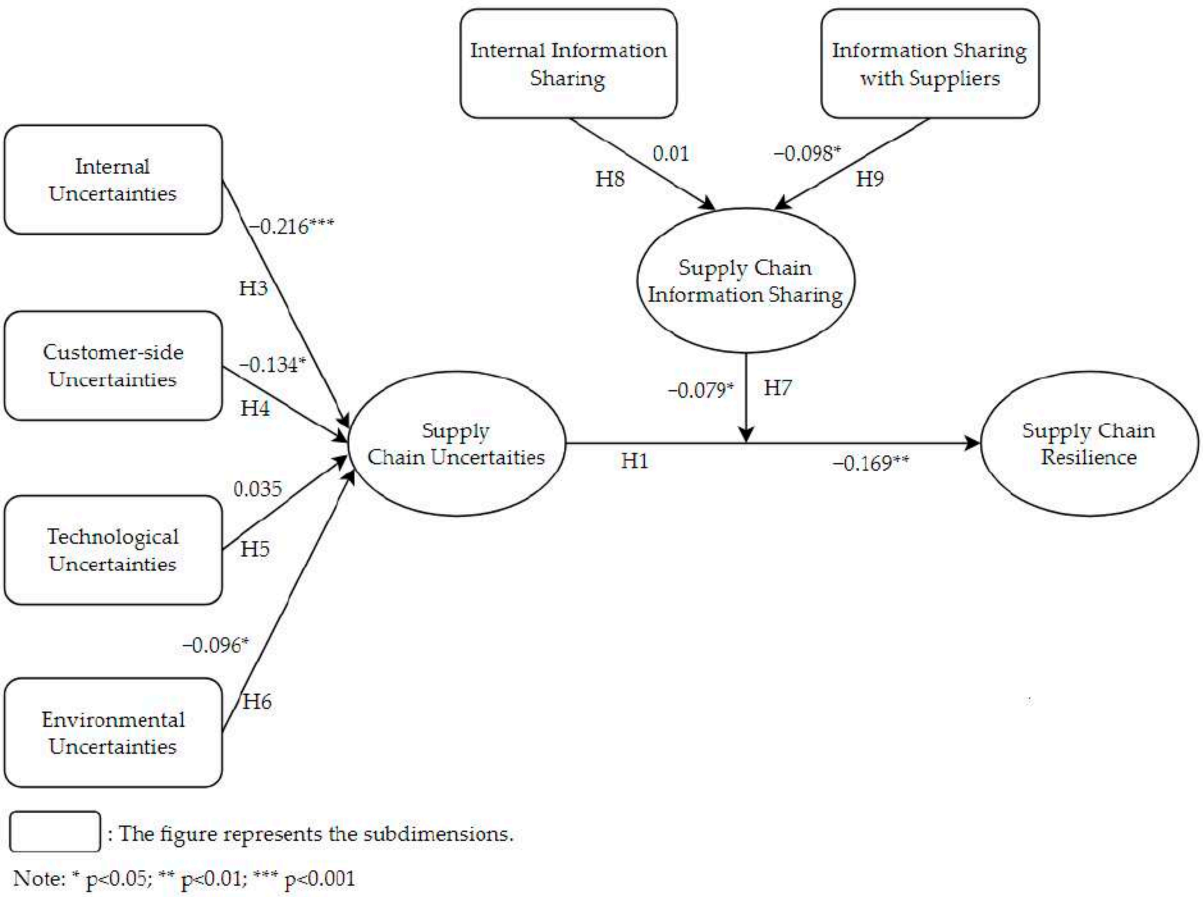

Figure 2. Path analysis results.

Table 4. Results of hypotheses testing.

Hypothesis	Paths	Std. Estimates (β)	*p*-Value	Results
H1	SCU→SCRES	−0.169	0.008 **	Supported
H3	SCU-I→SCRES	−0.216	***	Supported
H4	SCU-CS→SCRES	−0.134	0.034 *	Supported
H5	SCU-TECH→SCRES	0.035	0.588	Not Supported
H6	SCU-ENV→SCRES	−0.096	0.045 *	Supported
H7	SCU×IS→SCRES	−0.079	0.115	Not Supported
H8	SCU×ISI→SCRES	0.01	0.826	Not Supported
H8a	SCU-I×ISI→SCRES	0.05	0.433	Not Supported
H8b	SCU-CS×ISI→SCRES	0.012	0.795	Not Supported
H8c	SCU-TECH×ISI→SCRES	−0.129	0.044 *	Supported
H8d	SCU-ENV×ISI→SCRES	0.075	0.145	Not Supported
H9	SCU×ISS→SCRES	−0.098	0.040 *	Supported
H9a	SCU-I×ISS→SCRES	−0.215	0.525	Not Supported
H9b	SCU-CS×ISS→SCRES	−0.124	0.77	Not Supported
H9c	SCU-TECH×ISS→SCRES	−0.128	0.033 *	Supported
H9d	SCU-ENV×ISS→SCRES	0.067	0.287	Not Supported

Note 1: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Hypothesis H7 (β = −0.079, $p > 0.05$), which measures the overall moderating effect of SCIS, and hypothesis H8 (β = 0.01, $p > 0.05$), which states that internal information sharing has a moderating role, are rejected. However, the subhypothesis H8c (β = −0.129, $p < 0.05$), that internal information sharing has a moderating role in the relationship between technological uncertainty and SCRES, is supported. Although hypothesis H5, which measures the direct effect of technological uncertainty on SCRES, is found to be insignificant (β = 0.035, $p > 0.05$), a significant interaction emerged by taking internal information sharing into account. It is observed that high internal information sharing does not create a significant change in SCRES in both cases of low or high technological uncertainty. However, it is concluded that high levels of internal information sharing contribute significantly to the resilience of supply chains compared to low levels of internal information sharing, especially in the case of low technological uncertainty (see Figure 3).

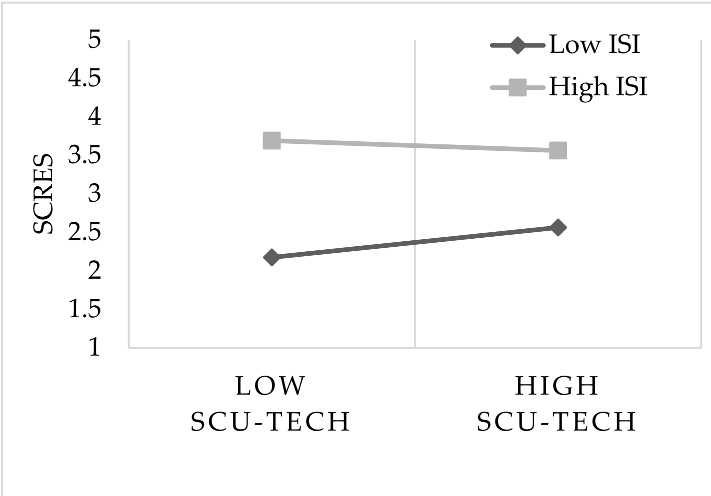

Figure 3. Slope plot of moderating variable analysis for hypothesis H8c.

Hypothesis H9, which states that information sharing with suppliers has a moderating role in the relationship between SCU and SCRES, is supported. SCU has a negative effect on SCRES negatively (β = −0.169). Information sharing with suppliers contributed to mitigating this negative effect (β = −0.098). However, as the level of uncertainty in the supply chain increases, high information sharing with suppliers does not prevent the weakening of SCRES. In cases of low or high uncertainty, a low level of information sharing does not create a significant change in SCRES. When the level of uncertainty reaches very high levels, however, there is little difference between low and high levels of information sharing with suppliers, and the positive contribution of information sharing to SCRES is reduced considerably (see Figure 4).

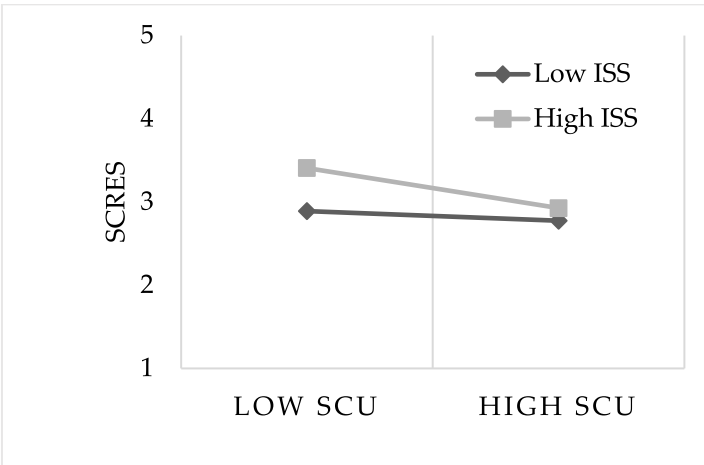

Figure 4. Slope plot of moderating variable analysis for hypothesis H9.

Hypothesis H9c (β = −0.129, $p < 0.05$), which states that information sharing with suppliers has a moderating role in the relationship between technological uncertainty and SCRES, is accepted. Although hypothesis H5, which measures the direct effect of technological uncertainty on SCRES, is not significant (β = 0.035, $p > 0.05$), there is a significant interaction (β = −0.128, $p < 0.05$) when information sharing with suppliers is taken into account. It is observed that a high level of information sharing with suppliers does not contribute to SCRES in low or high technological uncertainty situations; on the contrary, SCRES decreases with increasing technological uncertainty, even at a very low level. However, it has been found that a low level of information sharing with suppliers leads to a significant increase in SCRES, especially under conditions of high technological uncertainty. When the level of technological uncertainty reaches a very high level, a high or low level of information sharing with suppliers does not cause a change in SCRES (see Figure 5).

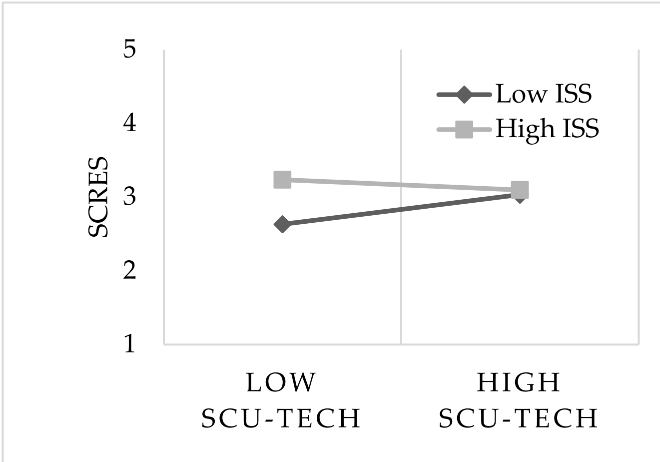

Figure 5. Slope plot of moderating variable analysis for hypothesis H9c.

5. Discussion

5.1. Theoretical Implications

This research, which investigates the effect of SCU on SCRES and the role of information sharing in the supply chain in this effect, has various theoretical contributions. First, it is predicted that SCU, which is the main hypothesis of the research, will negatively affect SCRES, and this prediction is supported by empirical methods. In parallel with this conclusion of the research, references [95,131,132] also put forward views that uncertainty will damage SCRES. Second, it is assumed that internal uncertainty will negatively affect SCRES, and this assumption is accepted according to the results of the analyses. Reference [133], in line with the results of this study, stated that resilience will be damaged in case of the emergence of internal uncertainty. Then, the hypothesis that demand uncertainty weakens SCRES was tested and empirically supported. Reference [98] argues that fluctuations in demand and high expectations reduce resilience performance, which is consistent with the results of this study. Parallel to the view of [47], who argue that resilience can be achieved by reducing environmental uncertainty, this study finds that there is an inverse relationship between environmental uncertainties and resilience.

The hypothesis proposed to determine whether changes in the level of information sharing in the supply chain lead to a differentiation in the negative relationship between SCU and SCRES (Hypothesis H7) was not significant. For this reason, no comparison could be made with studies in the literature [107,134,135], which indicate that information sharing reduces uncertainty [106] and, thus, reduces the negative impact of uncertainty on SCRES. However, in this study, internal information sharing and information sharing with suppliers were found to have moderating roles on the relationship between technological uncertainty and SCRES (H8c and H9c). On the other hand, information sharing with suppliers was also found to have a moderating role on the relationship between SCU and SCRES in general. In addition, the study also found that firms are reluctant to share information with their suppliers in situations of high uncertainty compared to low uncertainty. This finding is consistent with the view of [107] that firms find it risky to share information with their suppliers in situations of high uncertainty.

Another theoretical contribution of the research is the SCU scale, which differs from other studies in the literature. Reference [136] examined the SCU scale in three forms of demand, supply, and production uncertainty. References [67,116,137,138] examined the scale with the dimensions of business-side, customer-side, and environmental uncertainties. The studies by [13,117,139] analyzed the SCU scale with three dimensions: demand uncertainty, supply uncertainty, and technological uncertainty. In this study, based on CRBT, the SCU scale was constructed within the framework of five dimensions to contribute to theoretical development: supply uncertainty, internal uncertainty, customer-side uncertainty, technological uncertainty, and environmental uncertainty. Although each dimension differed from each other in the explanatory factor analysis, the supply uncertainty dimension was not included in the subsequent analyses as a result of the reliability analysis. Therefore, the research analyzed the SCU scale under four dimensions. As a result of the literature review, there is no other study that analyses the five-dimension scale created in this research.

5.2. Practical Implications

It is very important for managers to realize that sustainable supply chains are not only an element that accelerates the flow of operational activities but also a structure that contains a large number of uncertainty elements, and that these can cause unpredictable damage to the business and even to the entire supply chain. Managers have to put forward various reactive and proactive strategies in order to cope with and mitigate these disruptions. This study makes practical contributions in terms of showing whether the strategies put forward to ensure SCRES against related disruptions actually result in success in the face of uncertainties in the supply chain. The study also draws attention to the importance of information sharing among supply-chain members and shows that information sharing, with its various aspects, is an important management and strategy element in order to anticipate uncertainties and increase SCRES.

Basing the research on CRBT offers several practical contributions. CT suggests that more than one situation should be taken into account in the mobilization of a plan. Uncertain factors also require managers to diversify their strategic decisions and produce proactive strategies by taking different possibilities into account. RBT, on the other hand, argues that businesses should focus on their intangible capabilities that are difficult to imitate to continue their activities with high performance and competitiveness. By considering the uncertainties that may arise at any time and cause effective disruptions in the supply chain and by developing strategies for resilience, which have been frequently researched in recent years as an intangible capability that enables immediate response to disruptions in supply chains, organizations can recover from crisis situations with minimal damage and extend their life span. On the other hand, information sharing, which will enable the rapid distribution of changing situations among each member of the supply chain, is a driving force in emphasizing the unique capabilities of businesses and supply chains.

The findings of the study provide important practical contributions for managers responsible for the sustainability of complex supply chains in an uncertain environment. This research, which provides empirical evidence that uncertainty in the supply chain is a phenomenon that weakens resilience, suggests that managers should consider strategies such as maintaining safety stocks at the expense of cost, identifying alternative suppliers or retailers, having flexible production mechanisms that allow for diversity in goods or services, and establishing flexible and sustainable supply-chain contracts that enable sudden decision changes in times of crisis. The study also found that the type of uncertainty that causes the most damage to SCRES is internal uncertainty. It was concluded that unpredictable sudden changes in customer behaviour and external factors (such as exchange-rate fluctuations, natural disasters, legal procedures, etc.) beyond the control of the organization also weaken SCRES. It is recommended that managers should take the necessary precautions and develop strategies to increase resilience by considering customer-side and environmental uncertainties.

The study revealed that information sharing is highly effective in making supply chains resilient. In particular, it is found that information sharing with suppliers reduces the negative impact of SCU on SCRES. The finding that enterprises with a low level of information sharing can increase their resilience level even if uncertainty increases through information sharing should be taken into consideration by practitioners. In addition to contributing to the progress of Industry 4.0 and Logistics 4.0 with the results obtained, this study will also be useful in identifying certain areas that need attention in terms of information systems in logistics management. In summary, the contributions of this research to practice are listed below.

- Differing from the SCU scales in the literature, the fact that the scale used in this research is more inclusive will provide managers with a wider perspective in their observations and will make it easier for them to identify areas that they will have difficulty seeing;
- Taking into account the COVID-19 pandemic, which has recently caused radical changes around the world, businesses will have the opportunity to make a more detailed self assessment, taking into account the strategic information provided by this research;
- By adapting the strategies revealed in this research on SCRES, it will serve as a guide in determining the methods to overcome the fluctuations caused by unforeseen events;
- By integrating the information-sharing parameter with the field of management information systems, innovation-based information-sharing mechanisms can be created to improve SCRES in public- and private-sector organizations;
- By demonstrating that information exchanged among supply-chain members strengthens SCRES, this study offers managerial benefits.

5.3. Limitations and Future Research

This research has several limitations. Firstly, the research is limited on the basis of subject matter since it consists of SCU, SCIS, and SCRES. On the other hand, since the data collected for the research were obtained from internationally operating companies in Antalya, it was limited geographically and in the data set used. Since the participants consisted of lower, middle, and senior managers, other white-collar employees and blue-collar employees were not included in the research sample. In addition, since the data were obtained from companies in intensive supply-chain relationships, companies operating in the service sector were excluded from the scope. In addition, since the data were collected from private companies, employees in public institutions were not included in the research sample.

In future studies, the findings of this research can be compared with the analyses to be conducted on data collected from different geographies. Since the items on the survey form used in the research are more appropriate to be applied to the middle-upper managers of corporate firms, research to be conducted on the most developed firms in Turkey can provide outputs with a very high level of widespread impact. For example, the survey used in this study can be applied to the relevant managers in the Fortune 500 Turkey list, where the 500 companies with the highest turnover in Turkey are ranked, or in the companies registered with the Turkish Exporters Assembly (TIM), and a comparative analysis can be made based on the results. On the other hand, future studies can be conducted on selected sectors, and the results can be compared with the findings of this research. In addition, since the research model analyses the moderating role of information sharing on the impact of SCU on SCRES, it can be used in different ways in future studies. Although environmental uncertainties in the study address external factors independent of the supply chain, such as natural disasters, political and economic conjunctures, and legal regulations, sociocultural factors are ignored. To overcome this deficiency, the effect of environmental uncertainties caused by sociocultural factors on SCRES can be investigated in future studies. In addition, since the SCRES variable is considered under a single dimension in this study, it may be useful to examine the effect of various types of uncertainty on the concepts associated with SCRES, such as supply-chain agility, flexibility, re-engineering, collaboration, visibility, robustness, integration, and velocity.

6. Conclusions

This study addresses a topic that has not been sufficiently tested empirically, investigates to what extent SCRES is damaged in the face of SCU, and reveals which practices can help supply chains remain resilient under uncertainty. The study also investigates how information sharing by businesses with supply-chain members or other environmental factors can change the interaction between uncertainty and resilience. The results generally show that uncertainties in the supply chain negatively affect resilience. The technological uncertainty dimension has no significant effect on SCRES. Internal and customer-side uncertainty affected SCRES at a higher level than environmental uncertainty. Thus, it can be inferred from this result that environmental uncertainties, such as natural disasters, legal procedures, economic conditions, variable tariffs, etc., affect SCRES negatively to a lesser extent than the factors directly related to the supply chain.

According to the results of the research, the uncertainties that enterprises are exposed to are found to be internal, customer-side, environmental, supply, and technological uncertainties from small to large scale. This finding shows that, rather than internal processes, enterprises are more affected by external factors that they have limited chances to respond to. When the averages of the dimensions of the uncertainty in the supply-chain variable are analyzed, the dimension with the highest average is technological uncertainty. In other words, the participants think that businesses are most exposed to technological uncertainties. In order to minimize the negative effects of technological uncertainty, which the participants think exist at a high level, it is very important for enterprises to closely follow the current information technologies in order to increase their lifespan and sectoral competitiveness. This is because technological uncertainty not only slows down the operational processes of enterprises due to outdated machinery and equipment but also prevents the realization of effective information sharing within the enterprise or between stakeholders in the supply chain. The second dimension with the second highest uncertainty is supply uncertainty. A supplier's failure to deliver critical material on time is an event that occurs completely outside the buyer's organization and can create large fluctuations in the supply chain, resulting in high costs.

When information sharing is evaluated with all its elements, it is not found that it has a moderating role in the relationship between SCU and SCRES. However, it has been concluded that internal and supplier information sharing creates a change in the impact of technological uncertainties on resilience and that supplier information sharing mitigates the negative impact of uncertainties on resilience. Internal knowledge sharing causes a difference only in the impact of technological uncertainties on SCRES. On the other hand, information sharing with suppliers causes a difference in the effect of uncertainties in the supply chain on SCRES. Information sharing with suppliers, like internal information sharing, only has a role in causing a difference in the severity of the impact of technological uncertainties on SCRES. Considering these results, it can be concluded that logistics and supply-chain management should be considered as a separate subject in the field of information risk management.

Comparing the change in the level of SCRES caused by a high level of internal information sharing and a low level of internal information sharing, it is observed that there is a significant difference between them. This result shows that internal information sharing has a very important role in SCRES. As a result of information sharing within the organization, actions are taken instantly in line with the relevant information in the operational processes, which directly affects and strengthens the SCRES. While a high level of internal information sharing does not lead to a significant change in the severity of SCRES at different levels of technological uncertainty, a low level of information sharing contributes positively to SCRES even as the level of technological uncertainty increases. Although the effect of a high level of internal information sharing on increasing resilience is small when considering different uncertainty conditions, it should not be ignored that a high level of shared information directly contributes to a high level of resilience.

The results of the research underline the importance of implementing different strategies for companies operating in different conditions and draw attention to the fact that these strategies should be implemented with resources that are difficult to imitate, such as information. The fact that internal, customer, and environmental uncertainties have a negative impact on SCRES, but that technological uncertainty has no direct impact on resilience, supports the compatibility of the study with the CRBT. Although technological uncertainty does not have a direct effect on SCRES, there is an interaction between the relevant dimensions when internal and information sharing with suppliers is taken into account. In addition, this research, which recommends that firms should be cautious about sharing information with their suppliers under conditions of high uncertainty but should increase low-level information sharing under conditions of technological uncertainty, is compatible with CRBT and contains insights of strategic importance that will contribute to firms' competitive advantage. Based on CRBT, the research has helped to develop various information-sharing and resilience strategies to mitigate or cope with uncertainties perceived as threats to firms. Ultimately, the study suggests that by determining appropriate proactive and reactive approaches, and by taking into account internal and environmental conditions in determining the level of information sharing, negatively perceived uncertainties can be transformed into a phenomenon that enables companies to get ahead of their competitors.

Author Contributions: Conceptualization, A.E.C. and R.E.; Methodology, A.E.C. and R.E.; Validation, A.E.C.; Investigation, A.E.C. and R.E.; Resources, A.E.C.; Data curation, A.E.C.; Writing—original draft, A.E.C. and R.E.; Writing—review & editing, A.E.C. and R.E.; Supervision, R.E.; Project administration, R.E. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and the data of this study were obtained with the approval of the Scientific Research and Publication Ethics Board of Akdeniz University (266861—13 January 2022) for studies involving humans.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Acknowledgments: This study is derived from Artuğ Eren Coşkun's Ph.D. thesis called "The Moderating Role of Information Sharing in the Impact of Uncertainties on Resilience in Supply Chain Management: A Research on International Businesses".

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Davis, K.F.; Downs, S.; Gephart, J.A. Towards Food Supply Chain Resilience to Environmental Shocks. *Nat. Food* **2021**, *2*, 54–65. [CrossRef] [PubMed]
2. Ehrenhuber, I.; Treiblmaier, H.; Nowitzki, C.E.; Gerschberger, M. Toward a Framework for Supply Chain Resilience. *Int. J. Supply Chain Oper. Resil.* **2015**, *1*, 339–350. [CrossRef]
3. Mensah, P.; Merkuryev, Y. Developing a Resilient Supply Chain. *Procedia-Soc. Behav. Sci.* **2014**, *110*, 309–319. [CrossRef]
4. Salam, M.A.; Bajaba, S. The Role of Supply Chain Resilience and Absorptive Capacity in the Relationship between Marketing–Supply Chain Management Alignment and Firm Performance: A Moderated-Mediation Analysis. *J. Bus. Ind. Mark.* **2023**, *38*, 1545–1561. [CrossRef]
5. ur Rehman, O.; Ali, Y. Enhancing Healthcare Supply Chain Resilience: Decision-Making in a Fuzzy Environment. *Int. J. Logist. Manag.* **2022**, *33*, 520–546. [CrossRef]
6. Scholten, K.; Schilder, S. The Role of Collaboration in Supply Chain Resilience. *Supply Chain Manag.* **2015**, *20*, 471–484. [CrossRef]

7. Schroeder, M.; Lodemann, S. A Systematic Investigation of the Integration of Machine Learning into Supply Chain Risk Management. *Logistics* **2021**, *5*, 62. [CrossRef]
8. Lawrence, P.R.; Lorsch, J.W. Differentiation and Integration in Complex Organizations. *Adm. Sci. Q.* **1967**, *12*, 1–47. [CrossRef]
9. Miller, D. Environmental Fit Versus Internal Fit. *Organ. Sci.* **1992**, *3*, 159–178. [CrossRef]
10. Thompson, J.D.; Zald, M.N.; Scott, W.R. *Organizations in Action*; Routledge: New York, NY, USA, 2017; ISBN 9781315125930.
11. Schwark, B. Toward a Contingent Resource-Based View of Nonmarket Capabilities under Regulatory Uncertainty. In Proceedings of the 2nd Annual Conference on Competition and Regulation in Network Industries, Brussels, Belgium, 19 November 2010.
12. Aragón-Correa, J.A.; Sharma, S. A Contingent Resource-Based View of Proactive Corporate Environmental Strategy. *Acad. Manag. Rev.* **2003**, *28*, 71. [CrossRef]
13. Chen, I.J.; Paulraj, A. Towards a Theory of Supply Chain Management: The Constructs and Measurements. *J. Oper. Manag.* **2004**, *22*, 119–150. [CrossRef]
14. Vahlne, J.E.; Hamberg, M.; Schweizer, R. Management under Uncertainty—The Unavoidable Risk-Taking. *Multinatl. Bus. Rev.* **2017**, *25*, 91–109. [CrossRef]
15. Galbraith, J. *Designing Complex Organizations*; Addison-Wesley Publishing Company: Reading, MA, USA, 1973.
16. Yang, B.; Burns, N.D.; Backhouse, C.J. Management of Uncertainty through Postponement. *Int. J. Prod. Res.* **2004**, *42*, 1049–1064. [CrossRef]
17. Davis, T. Effective Supply Chain Management. *Sloan Manag. Rev.* **1993**, *34*, 35–46.
18. Hult, G.T.M.; Craighead, C.W.; Ketchen, D.J., Jr.; Ketchen, D.J. Risk Uncertainty and Supply Chain Decisions: A Real Options Perspective. *Decis. Sci.* **2010**, *41*, 435–458. [CrossRef]
19. Van Der Vorst, J.G.A.J.; Beulens, A.J.M. Identifying Sources of Uncertainty to Generate Supply Chain Redesign Strategies. *Int. J. Phys. Distrib. Logist. Manag.* **2002**, *32*, 409–430. [CrossRef]
20. Simangunsong, E.; Hendry, L.C.; Stevenson, M. Supply-Chain Uncertainty: A Review and Theoretical Foundation for Future Research. *Int. J. Prod. Res.* **2012**, *50*, 4493–4523. [CrossRef]
21. Flynn, B.B.; Koufteros, X.; Lu, G. On Theory in Supply Chain Uncertainty and Its Implications for Supply Chain Integration. *J. Supply Chain Manag.* **2016**, *52*, 3–27. [CrossRef]
22. de Lima, F.A.; Seuring, S.; Sauer, P.C. A Systematic Literature Review Exploring Uncertainty Management and Sustainability Outcomes in Circular Supply Chains. *Int. J. Prod. Res.* **2022**, *60*, 6013–6046. [CrossRef]
23. Peng, H.; Shen, N.; Liao, H.; Xue, H.; Wang, Q. Uncertainty Factors, Methods, and Solutions of Closed-Loop Supply Chain—A Review for Current Situation and Future Prospects. *J. Clean. Prod.* **2020**, *254*, 120032. [CrossRef]
24. Marcos, J.T.; Scheller, C.; Godina, R.; Spengler, T.S.; Carvalho, H. Sources of Uncertainty in the Closed-Loop Supply Chain of Lithium-Ion Batteries for Electric Vehicles. *Clean. Logist. Supply Chain* **2021**, *1*, 100006. [CrossRef]
25. Sato, Y.; Tse, Y.K.; Tan, K.H. Managers' Risk Perception of Supply Chain Uncertainties. *Ind. Manag. Data Syst.* **2020**, *120*, 1617–1634. [CrossRef]
26. Angkiriwang, R.; Pujawan, I.N.; Santosa, B. Managing Uncertainty through Supply Chain Flexibility: Reactive vs. Proactive Approaches. *Prod. Manuf. Res.* **2014**, *2*, 50–70. [CrossRef]
27. Hoffmann, P.; Schiele, H.; Krabbendam, K. Uncertainty, Supply Risk Management and Their Impact on Performance. *J. Purch. Supply Manag.* **2013**, *19*, 199–211. [CrossRef]
28. Sreedevi, R.; Saranga, H. Uncertainty and Supply Chain Risk: The Moderating Role of Supply Chain Flexibility in Risk Mitigation. *Int. J. Prod. Econ.* **2017**, *193*, 332–342. [CrossRef]
29. Gokarn, S.; Kuthambalayan, T.S. Creating Sustainable Fresh Produce Supply Chains by Managing Uncertainties. *J. Clean. Prod.* **2019**, *207*, 908–919. [CrossRef]
30. Tse, Y.K.; Zhang, M.; Zeng, W.; Ma, J. Perception of Supply Chain Quality Risk: Understanding the Moderation Role of Supply Market Thinness. *J. Bus. Res.* **2021**, *122*, 822–834. [CrossRef]
31. Sopha, B.M.; Jie, F.; Himadhani, M. Analysis of the Uncertainty Sources and SMEs' Performance. *J. Small Bus. Entrep.* **2021**, *33*, 1–27. [CrossRef]
32. Tse, Y.K.; Matthews, R.L.; Tan, K.H.; Sato, Y.; Pongpanich, C. Unlocking Supply Chain Disruption Risk within the Thai Beverage Industry. *Ind. Manag. Data Syst.* **2016**, *116*, 21–42. [CrossRef]
33. Asbjørnslett, B.E.; Rausand, M. Assess the Vulnerability of Your Production System. *Prod. Plan. Control* **1999**, *10*, 219–229. [CrossRef]
34. Rice, J.B.; Caniato, F. Building a Secure and Resilience Supply Chain. *Supply Chain Manag. Rev.* **2003**, *5*, 22–30.
35. Holling, C.S. Resilience and Stability of Ecological Systems. *Annu. Rev. Ecol. Syst.* **1973**, *4*, 1–23. [CrossRef]
36. Sheffi, Y. *The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage*; MIT Press: Cambridge, MA, USA; Paperback: London, UK, 2005; ISBN 9788578110796.
37. Shuai, Y.; Wang, X.; Zhao, L. Research on Measuring Method of Supply Chain Resilience Based on Biological Cell Elasticity Theory. In Proceedings of the 2011 IEEE International Conference on Industrial Engineering and Engineering Management, Singapore, 6–9 December 2011; pp. 264–268. [CrossRef]
38. Pettit, T.J.; Fiksel, J.; Croxton, K.L. Ensuring Supply Chain Resilience: Development of a Conceptual Framework. *J. Bus. Logist.* **2010**, *31*, 1–21. [CrossRef]

39. van Hoek, R. Research Opportunities for a More Resilient Post-COVID-19 Supply Chain—Closing the Gap between Research Findings and Industry Practice. *Int. J. Oper. Prod. Manag.* **2020**, *40*, 341–355. [CrossRef]
40. Christopher, M.; Peck, H. Building the Resilient Supply Chain. *Int. J. Logist. Manag.* **2004**, *15*, 1–14. [CrossRef]
41. Johnson, N.; Elliott, D.; Drake, P. Exploring the Role of Social Capital in Facilitating Supply Chain Resilience. *Supply Chain Manag.* **2013**, *18*, 324–336. [CrossRef]
42. Emenike, S.N.; Falcone, G. A Review on Energy Supply Chain Resilience through Optimization. *Renew. Sustain. Energy Rev.* **2020**, *134*, 110088. [CrossRef]
43. Sabahi, S.; Parast, M.M. Firm Innovation and Supply Chain Resilience: A Dynamic Capability Perspective. *Int. J. Logist. Res. Appl.* **2020**, *23*, 254–269. [CrossRef]
44. Wieland, A.; Stevenson, M.; Melnyk, S.A.; Davoudi, S.; Schultz, L. Thinking Differently about Supply Chain Resilience: What We Can Learn from Social-Ecological Systems Thinking. *Int. J. Oper. Prod. Manag.* **2023**, *43*, 1–21. [CrossRef]
45. Jain, V.; Kumar, S.; Soni, U.; Chandra, C. Supply Chain Resilience: Model Development and Empirical Analysis. *Int. J. Prod. Res.* **2017**, *55*, 6779–6800. [CrossRef]
46. Brusset, X.; Teller, C. Supply Chain Capabilities, Risks, and Resilience. *Int. J. Prod. Econ.* **2017**, *184*, 59–68. [CrossRef]
47. Chowdhury, M.M.H.; Quaddus, M.; Agarwal, R. Supply Chain Resilience for Performance: Role of Relational Practices and Network Complexities. *Supply Chain Manag.* **2019**, *24*, 659–676. [CrossRef]
48. Qader, G.; Junaid, M.; Abbas, Q.; Mubarik, M.S. Industry 4.0 Enables Supply Chain Resilience and Supply Chain Performance. *Technol. Forecast. Soc. Chang.* **2022**, *185*, 122026. [CrossRef]
49. Hussain, G.; Nazir, M.S.; Rashid, M.A.; Sattar, M.A. From Supply Chain Resilience to Supply Chain Disruption Orientation: The Moderating Role of Supply Chain Complexity. *J. Enterp. Inf. Manag.* **2023**, *36*, 70–90. [CrossRef]
50. Lin, J.; Lin, S.; Benitez, J.; Luo, X.; Ajamieh, A. How to Build Supply Chain Resilience: The Role of Fit Mechanisms between Digitally-Driven Business Capability and Supply Chain Governance. *Inf. Manag.* **2023**, *60*, 103747. [CrossRef]
51. Lotfi, Z.; Mukhtar, M.; Sahran, S.; Zadeh, A.T. Information Sharing in Supply Chain Management. *Procedia Technol.* **2013**, *11*, 298–304. [CrossRef]
52. Samaddar, S.; Nargundkar, S.; Daley, M. Inter-Organizational Information Sharing: The Role of Supply Network Configuration and Partner Goal Congruence. *Eur. J. Oper. Res.* **2006**, *174*, 744–765. [CrossRef]
53. Barua, A.; Ravindran, S.; Whinston, A.B. Enabling Information Sharing within Organizations. *Inf. Technol. Manag.* **2007**, *8*, 31–45. [CrossRef]
54. Lee, H.L.; Whang, S. Information Sharing in a Supply Chain. *Int. J. Manuf. Technol. Manag.* **2000**, *1*, 79–93. [CrossRef]
55. Erturgut, R. *Lojistik ve Tedarik Zinciri Yönetimi*; Nobel Yayıncılık: Ankara, Turkey, 2016.
56. Chen, F.; Drezner, Z.; Ryan, J.K.; Simchi-Levi, D. Quantifying the Bullwhip Effect in a Simple Supply Chain: The Impact of Forecasting, Lead Times, and Information. *Manag. Sci.* **2000**, *46*, 436–443. [CrossRef]
57. Ouyang, Y. The Effect of Information Sharing on Supply Chain Stability and the Bullwhip Effect. *Eur. J. Oper. Res.* **2007**, *182*, 1107–1121. [CrossRef]
58. Tran, T.T.H.; Childerhouse, P.; Deakins, E. Supply Chain Information Sharing: Challenges and Risk Mitigation Strategies. *J. Manuf. Technol. Manag.* **2016**, *27*, 1102–1126. [CrossRef]
59. Colicchia, C.; Creazza, A.; Noè, C.; Strozzi, F. Information Sharing in Supply Chains: A Review of Risks and Opportunities Using the Systematic Literature Network Analysis (SLNA). *Supply Chain Manag.* **2019**, *24*, 5–21. [CrossRef]
60. Zhang, J.; Chen, J. Coordination of Information Sharing in a Supply Chain. *Int. J. Prod. Econ.* **2013**, *143*, 178–187. [CrossRef]
61. Khan, M.; Hussain, M.; Saber, H.M. Information Sharing in a Sustainable Supply Chain. *Int. J. Prod. Econ.* **2016**, *181*, 208–214. [CrossRef]
62. Han, G.; Dong, M. Trust-Embedded Coordination in Supply Chain Information Sharing. *Int. J. Prod. Res.* **2015**, *53*, 5624–5639. [CrossRef]
63. Shang, W.; Ha, A.Y.; Tong, S. Information Sharing in a Supply Chain with a Common Retailer. *Manag. Sci.* **2016**, *62*, 245–263. [CrossRef]
64. Huang, S.; Guan, X.; Chen, Y.J. Retailer Information Sharing with Supplier Encroachment. *Prod. Oper. Manag.* **2018**, *27*, 1133–1147. [CrossRef]
65. Jeong, K.; Hong, J.D. The Impact of Information Sharing on Bullwhip Effect Reduction in a Supply Chain. *J. Intell. Manuf.* **2019**, *30*, 1739–1751. [CrossRef]
66. Gruzauskas, V.; Burinskiene, A.; Krisciunas, A. Application of Information-Sharing for Resilient and Sustainable Food Delivery in Last-Mile Logistics. *Mathematics* **2023**, *11*, 303. [CrossRef]
67. Wang, M.; Jie, F.; Abareshi, A. The Measurement Model of Supply Chain Uncertainty and Risk in the Australian Courier Industry. *Oper. Supply Chain Manag. An Int. J.* **2014**, *7*, 89–96. [CrossRef]
68. Han, Z.; Huo, B.; Zhao, X. Backward Supply Chain Information Sharing: Who Does It Benefit? *Supply Chain Manag. An Int. J.* **2021**. [CrossRef]
69. Bai, C.; Govindan, K.; Huo, B. The Contingency Effects of Dependence Relationship on Supply Chain Information Sharing and Agility. *Int. J. Logist. Manag.* **2023**, *34*, 1808–1832. [CrossRef]
70. Wang, Z.; Ye, F.; Tan, K.H. Effects of Managerial Ties and Trust on Supply Chain Information Sharing and Supplier Opportunism. *Int. J. Prod. Res.* **2014**, *52*, 7046–7061. [CrossRef]

71. Burns, T.; Stalker, G.M. *The Management of Innovation*; Oxford University Press: London, UK, 1961.
72. Kembro, J.; Selviaridis, K.; Näslund, D. Theoretical Perspectives on Information Sharing in Supply Chains: A Systematic Literature Review and Conceptual Framework. *Supply Chain Manag.* **2014**, *19*, 609–625. [CrossRef]
73. Blackhurst, J.; Dunn, K.S.; Craighead, C.W. An Empirically Derived Framework of Global Supply Resiliency. *J. Bus. Logist.* **2011**, *32*, 374–391. [CrossRef]
74. Olavarrieta, S.; Ellinger, A.E. Resource-Based Theory and Strategic Logistics Research. *Int. J. Phys. Distrib. Logist. Manag.* **1997**, *27*, 559–587. [CrossRef]
75. Lai, K. Service Capability and Performance of Logistics Service Providers. *Transp. Res. Part E Logist. Transp. Rev.* **2004**, *40*, 385–399. [CrossRef]
76. Gligor, D.M.; Holcomb, M. The Road to Supply Chain Agility: An RBV Perspective on the Role of Logistics Capabilities. *Int. J. Logist. Manag.* **2014**, *25*, 160–179. [CrossRef]
77. Ralston, P.M.; Grawe, S.J.; Daugherty, P.J. Logistics Salience Impact on Logistics Capabilities and Performance. *Int. J. Logist. Manag.* **2013**, *24*, 136–152. [CrossRef]
78. Peteraf, M.A. The Cornerstones of Competitive Advantage: A Resource-Based View. *Strateg. Manag. J.* **1993**, *14*, 179–191. [CrossRef]
79. Barney, J. Firm Resources and Sustained Competitive Advantage. *J. Manag.* **1991**, *17*, 99–120. [CrossRef]
80. Koç, E.; Delibaş, M.B.; Anadol, Y. Environmental Uncertainties and Competitive Advantage: A Sequential Mediation Model of Supply Chain Integration and Supply Chain Agility. *Sustainability* **2022**, *14*, 8928. [CrossRef]
81. Wang, M.; Jie, F.; Abareshi, A. A Conceptual Framework for Mitigating Supply Chain Uncertainties and Risks in the Courier Industry. *Int. J. Supply Chain Oper. Resil.* **2015**, *1*, 319. [CrossRef]
82. Roscoe, S.; Skipworth, H.; Aktas, E.; Habib, F. Managing Supply Chain Uncertainty Arising from Geopolitical Disruptions: Evidence from the Pharmaceutical Industry and Brexit. *Int. J. Oper. Prod. Manag.* **2020**, *40*, 1499–1529. [CrossRef]
83. Barney, J.B.; Ketchen, D.J.; Wright, M. The Future of Resource-Based Theory: Revitalization or Decline? *J. Manag.* **2011**, *37*, 1299–1315. [CrossRef]
84. Ahmed, W.; Khan, M.A.; Najmi, A.; Khan, S.A. Strategizing Risk Information Sharing Framework among Supply Chain Partners for Financial Performance. *Supply Chain Forum Int. J.* **2023**, *24*, 233–250. [CrossRef]
85. Ling-yee, L. Marketing Resources and Performance of Exhibitor Firms in Trade Shows: A Contingent Resource Perspective. *Ind. Mark. Manag.* **2007**, *36*, 360–370. [CrossRef]
86. Donaldson, L. *The Contingency Theory of Organizations*; Sage Publications: Thousand Oaks, CA, USA, 2001.
87. Brandon-Jones, E.; Squire, B.; Autry, C.W.; Petersen, K.J. A Contingent Resource-Based Perspective of Supply Chain Resilience and Robustness. *J. Supply Chain Manag.* **2014**, *50*, 55–73. [CrossRef]
88. Fredericks, E. Infusing Flexibility into Business-to-Business Firms: A Contingency Theory and Resource-Based View Perspective and Practical Implications. *Ind. Mark. Manag.* **2005**, *34*, 555–565. [CrossRef]
89. Birkie, S.E.; Trucco, P.; Fernandez Campos, P. Effectiveness of Resilience Capabilities in Mitigating Disruptions: Leveraging on Supply Chain Structural Complexity. *Supply Chain Manag.* **2017**, *22*, 506–521. [CrossRef]
90. Agarwal, N.; Seth, N. Analysis of Supply Chain Resilience Barriers in Indian Automotive Company Using Total Interpretive Structural Modelling. *J. Adv. Manag. Res.* **2021**, *18*, 758–781. [CrossRef]
91. Ambulkar, S.; Blackhurst, J.; Grawe, S. Firm's Resilience to Supply Chain Disruptions: Scale Development and Empirical Examination. *J. Oper. Manag.* **2015**, *33–34*, 111–122. [CrossRef]
92. Christopher, M. *Logistics & Supply Chain Management*, 4th ed.; Pearson Education Limited: Dorchester, UK, 2011.
93. Fiksel, J.; Polyviou, M.; Croxton, K.L.; Pettit, T.J. From Risk to Resilience: Learning to Deal with Disruption. *MIT Sloan Manag. Rev.* **2015**, *56*, 79–86.
94. Liu, G. Three Essays on Mass Customization: Examining Impacts of Work Design, Supply Chain Uncertainty Management, and Functional Integration on Mass Customization. Ph.D. Dissertation, Faculty of the Graduate School of the University of Minnesota, UMI Microform, Ann Arbor, MI, USA, 2007.
95. Gölgeci, I.; Ponomarov, S.Y. How Does Firm Innovativeness Enable Supply Chain Resilience? The Moderating Role of Supply Uncertainty and Interdependence. *Technol. Anal. Strateg. Manag.* **2015**, *27*, 267–282. [CrossRef]
96. Tang, C.S. Perspectives in Supply Chain Risk Management. *Int. J. Prod. Econ.* **2006**, *103*, 451–488. [CrossRef]
97. Gu, M.; Yang, L.; Huo, B. The Impact of Information Technology Usage on Supply Chain Resilience and Performance: An Ambidexterous View. *Int. J. Prod. Econ.* **2021**, *232*, 107956. [CrossRef]
98. Spiegler, V.L.M.; Naim, M.M.; Wikner, J. A Control Engineering Approach to the Assessment of Supply Chain Resilience. *Int. J. Prod. Res.* **2012**, *50*, 6162–6187. [CrossRef]
99. Ramanathan, U.; Aluko, O.; Ramanathan, R. Supply Chain Resilience and Business Responses to Disruptions of the COVID-19 Pandemic. *Benchmarking* **2022**, *29*, 2275–2290. [CrossRef]
100. Williams, T.A.; Gruber, D.A.; Sutcliffe, K.M.; Shepherd, D.A.; Zhao, E.Y. Organizational Response to Adversity: Fusing Crisis Management and Resilience Research Streams. *Acad. Manag. Ann.* **2017**, *11*, 733–769. [CrossRef]
101. Ghosh, S.; Bhowmick, B. Technological Uncertainty: Exploring Factors in Indian Start-Ups. In Proceedings of the IEEE Global Humanitarian Technology Conference (GHTC 2014), San Jose, CA, USA, 10–13 October 2014; pp. 425–432.

102. Al-Hakimi, M.A.; Borade, D.B.; Saleh, M.H.; Nasr, M.A.A. The Moderating Role of Supplier Relationship on the Effect of Postponement on Supply Chain Resilience under Different Levels of Environmental Uncertainty. *Prod. Manuf. Res.* **2022**, *10*, 383–409. [CrossRef]
103. Trkman, P.; McCormack, K. Supply Chain Risk in Turbulent Environments-A Conceptual Model for Managing Supply Chain Network Risk. *Int. J. Prod. Econ.* **2009**, *119*, 247–258. [CrossRef]
104. Sydow, J.; Müller-Seitz, G.; Provan, K.G. Managing Uncertainty in Alliances and Networks—From Governance to Practice. In *Managing Knowledge in Strategic Alliances*; Das, T.K., Ed.; Information Age Publishing: Charlotte, NC, USA, 2013; pp. 1–43.
105. Tan, H.-C.; Soh, K.L.; Wong, W.P.; Tseng, M.-L. Enhancing Supply Chain Resilience by Counteracting the Achilles Heel of Information Sharing. *J. Enterp. Inf. Manag.* **2022**, *35*, 817–846. [CrossRef]
106. Zhou, H.; Benton, W.C. Supply Chain Practice and Information Sharing. *J. Oper. Manag.* **2007**, *25*, 1348–1365. [CrossRef]
107. Li, S.; Lin, B. Accessing Information Sharing and Information Quality in Supply Chain Management. *Decis. Support Syst.* **2006**, *42*, 1641–1656. [CrossRef]
108. Darkow, P.M. Beyond "Bouncing Back": Towards an Integral, Capability-Based Understanding of Organizational Resilience. *J. Contingencies Cris. Manag.* **2019**, *27*, 145–156. [CrossRef]
109. Li, G.; Li, X.; Liu, M. Inducing Supplier Backup via Manufacturer Information Sharing under Supply Disruption Risk. *Comput. Ind. Eng.* **2023**, *176*, 108914. [CrossRef] [PubMed]
110. Syed, M.W.; Li, J.Z.; Junaid, M.; Ye, X.; Ziaullah, M. An Empirical Examination of Sustainable Supply Chain Risk and Integration Practices: A Performance-Based Evidence from Pakistan. *Sustainability* **2019**, *11*, 5334. [CrossRef]
111. Chen, C.; Gu, T.; Cai, Y.; Yang, Y. Impact of Supply Chain Information Sharing on Performance of Fashion Enterprises: An Empirical Study Using SEM. *J. Enterp. Inf. Manag.* **2019**, *32*, 913–935. [CrossRef]
112. Cachon, G.P.; Fisher, M. Supply Chain Inventory Management and the Value of Shared Information. *Manag. Sci.* **2000**, *46*, 1032–1048. [CrossRef]
113. Yang, L.; Huo, B.; Gu, M. The Impact of Information Sharing on Supply Chain Adaptability and Operational Performance. *Int. J. Logist. Manag.* **2022**, *33*, 590–619. [CrossRef]
114. Krejcie, R.V.; Morgan, W.D. Determining Sample Size for Research Activities. *Educ. Psychol. Meas.* **1970**, *30*, 607–610. [CrossRef]
115. Sekaran, U. *Research Methods for Business: A Skill-Building Approach*, 4th ed.; John Wiley & Sons, Inc.: New York, NY, USA, 2003; ISBN 9781119111931.
116. Haider, S.N.; Siddiqui, D.A. Impact of Logistics Capabilities on Mitigation of Supply Chain Uncertainty and Risk in Courier Firms in Pakistan. *SSRN Electron. J.* **2018**. [CrossRef]
117. Fynes, B.; de Búrca, S.; Marshall, D. Environmental Uncertainty, Supply Chain Relationship Quality and Performance. *J. Purch. Supply Manag.* **2004**, *10*, 179–190. [CrossRef]
118. Huo, B.; Zhao, X.; Zhou, H. The Effects of Competitive Environment on Supply Chain Information Sharing and Performance: An Empirical Study in China. *Prod. Oper. Manag.* **2014**, *23*, 552–569. [CrossRef]
119. Ponomarov, S.Y. Antecedents and Consequences of Supply Chain Resilience: A Dynamic Capabilities Perspective. Ph.D. Dissertation, The University of Tennessee, Knoxville, TN, USA, 2012.
120. Podsakoff, P.M.; MacKenzie, S.B.; Lee, J.-Y.; Podsakoff, N.P. Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. *J. Appl. Psychol.* **2003**, *88*, 879–903. [CrossRef] [PubMed]
121. Kline, R.B. *Principles and Practice of Structural Equation Modeling*; Kenny, D.A., Little, T.D., Eds.; The Guilford Press: New York, NY, USA; London, UK, 2011; ISBN 9781606238776.
122. Gefen, D.; Straub, D. A Practical Guide to Factorial Validity Using PLS-Graph: Tutorial and Annotated Example. *Commun. Assoc. Inf. Syst.* **2005**, *16*, 91–109. [CrossRef]
123. Ho, R. *Handbook of Univariate and Multivariate Data Analysis with IBM SPSS*, 2nd ed.; CRC Press: Boca Raton, FL, USA; London, UK; New York, NY, USA, 2014.
124. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. *Multivariate Data Analysis*, 7th ed.; Pearson Education Limited: Harlow, UK, 2014.
125. Gray, C.D.; Kinnear, P.R. *IBM SPSS Statistics 19 Made Simple*; Psychology Press: New York, NY, USA, 2012; ISBN 9781848720695.
126. Brown, T.A. *Confirmatory Factor Analysis for Applied Research*; Kenny, D.A., Ed.; The Guilford Press: New York, NY, USA, 2007; Volume 44.
127. Fornell, C.; Larcker, D.F. Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *J. Mark. Res.* **1981**, *18*, 39. [CrossRef]
128. Raykov, T.; Grayson, D. A Test for Change of Composite Reliability in Scale Development. *Multivariate Behav. Res.* **2003**, *38*, 143–159. [CrossRef]
129. Ab Hamid, M.R.; Sami, W.; Mohmad Sidek, M.H. Discriminant Validity Assessment: Use of Fornell & Larcker Criterion versus HTMT Criterion. *J. Phys. Conf. Ser.* **2017**, *890*, 012163. [CrossRef]
130. Ullman, J.B.; Bentler, P.M. Structural Equation Modeling. In *Handbook of Psychology*; Weiner, I.B., Ed.; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2013; pp. 661–690, ISBN 9781119111931.
131. Cheng, J.H.; Lu, K.L. Enhancing Effects of Supply Chain Resilience: Insights from Trajectory and Resource-Based Perspectives. *Supply Chain Manag.* **2017**, *22*, 329–340. [CrossRef]

132. Fiksel, J. From Risk to Resilience. In *Resilient by Design*; Island Press/Center for Resource Economics: Washington, DC, USA, 2015; pp. 19–34, ISBN 9781610915885.
133. Akter, S.; Debnath, B.; Bari, A.B.M.M. A Grey Decision-Making Trial and Evaluation Laboratory Approach for Evaluating the Disruption Risk Factors in the Emergency Life-Saving Drugs Supply Chains. *Healthc. Anal.* **2022**, *2*, 100120. [CrossRef]
134. Dubey, R.; Gunasekaran, A.; Childe, S.J.; Papadopoulos, T.; Blome, C.; Luo, Z. Antecedents of Resilient Supply Chains: An Empirical Study. *IEEE Trans. Eng. Manag.* **2019**, *66*, 8–19. [CrossRef]
135. Ruel, S.; Ouabouch, L.; Shaaban, S. Supply Chain Uncertainties Linked to Information Systems: A Case Study Approach. *Ind. Manag. Data Syst.* **2017**, *117*, 1093–1108. [CrossRef]
136. Ho, C.F.; Chi, Y.P.; Tai, Y.M. A Structural Approach to Measuring Uncertainty in Supply Chains. *Int. J. Electron. Commer.* **2005**, *9*, 91–114. [CrossRef]
137. Rodrigues, V.S.; Stantchev, D.; Potter, A.; Naim, M.; Whiteing, A. Establishing a Transport Operation Focused Uncertainty Model for the Supply Chain. *Int. J. Phys. Distrib. Logist. Manag.* **2008**, *38*, 388–411. [CrossRef]
138. Wang, M. Impacts of Supply Chain Uncertainty and Risk on the Logistics Performance. *Asia Pacific J. Mark. Logist.* **2018**, *30*, 689–704. [CrossRef]
139. Perdana, Y.R. Supply Chain Uncertainty: An Empirical Study of Indonesia'S Agro-Industry. *Agrointek J. Teknol. Ind. Pertan.* **2021**, *15*, 910–920. [CrossRef]