Developing Resilience Strategies amid Supply Chain Risks in the Automotive Industry: A Stakeholder Theory Perspective

Luay Jum'a[a], Salam Qamardin[a], Muhammad Ikram[b1]

[a] *Logistics Sciences Department, Business School, German Jordanian University, Amman 11180, Jordan*

[b] *School of Business Administration, Al Akhawayn University in Ifrane, Ave. Hassan II, Ifrane, P.O. Box 104 53000 Morocco*

Abstract

Managing automotive supply chain risks contributes to achieving sustainability goals, including ensuring business continuity, maintaining production and delivery schedules and reducing environmental impact. Therefore, this study aims to investigate the risks confronting the supply chain in the automotive industry through the moderating effect of reactive and proactive resilience strategies. The stakeholder theory perspective was used in this study to examine supply chain risk in the automotive industry. A quantitative method was employed, resulting in 157 valid responses. The results reveal that demand risk had the most significant effect on auto dealer performance, followed by logistics/transportation, production, and supply risk. Notably, proactive resilience strategies were found to significantly impact the relationship between risk and performance. The findings underscore the importance of proactive measures in mitigating the performance impacts of supply chain risk. This study contributes a theoretical framework by identifying four major supply chain risks and seven proactive and twelve reactive strategies. In addition, the study was conducted through the lens of stakeholder theory, emphasizing the importance of suppliers, manufacturers and dealers cooperating to establish a reliable supply chain.

Keywords: Supply chain risk; resilience strategies; automotive supply chain; crisis risk management; automotive dealer performance; stakeholder theory

1. Introduction

Supply chain risk has emerged as a critical determinant of organizational competitiveness and sustainability in recent years (Balakrishnan and Ramanathan, 2021). The convergence of factors such as shorter product life cycles, globalization, increased customer expectations, and cost reduction initiatives within supply chains (SCs) has increased the frequency, severity, and diversity of these risks (Reshad et al.,

[1] Corresponding Author (Muhammad Ikram; i.muhammad@aui.ma)

2023). Consequently, SCs have become more susceptible to disruptions, making risk management a critical aspect of logistics (Fan & Stevenson, 2018). Natural catastrophes, financial crises, and acts of terrorism have consistently disrupted SC operations in recent years. Events such as the Fukushima Daiichi Nuclear Power Plant explosion in 2011 and port explosions in Beijing had far-reaching consequences for global industries, particularly the automotive sector (Haraguchi & Lall, 2015). The COVID-19 pandemic, a global crisis, has further underscored the vulnerability of green SCs, which impacts financial aspects, lead times, demand patterns, and production efficiency (Malviya et al., 2018; Moosavi et al., 2022). Therefore, stakeholders in the automotive industry, including manufacturers, suppliers, logistics providers, policymakers, and even sustainability advocates, and customers care about ensuring a resilient SC (Shashi et al., 2020). Resilient SC is vital for maintaining production continuity, reducing costs, and lessening negative environmental impacts (Ngo et al., 2024).

SC risks in the automotive industry can stem from various sources, either man-made or natural hazards (Ho et al., 2015). An event that hinders the flow of products and services in an SC is termed an SC disruption, with potential negative impacts on a company's green and financial performance in the short and long term (Shashi et al., 2020). The COVID-19 pandemic, identified as one of the most severe disruptions in recent history, necessitates the development of resilient SCs to withstand and recover from significant interruptions (Ivanov & Dolgui, 2020).

However, we do not fully understand which resilience strategies are most effective, specifically for the automotive sector, and how these strategies can address economic and environmental sustainability simultaneously (Gedam et al., 2023). To address these challenges, companies need a framework for constructing pandemic strategies tailored to the uncertainties posed by events such as the COVID-19 pandemic (Ivanov, 2022). Various models and strategies have been proposed for managing SC risks and reducing disruptions caused by different risk factors (Huma & Siddiqui, 2019; Mathiyazhagan el al., 2020). Nonetheless, no studies have classified resilience strategies as proactive or reactive and examined their impact simultaneously on dealers at the end of the automotive supply chain.

Moreover, the COVID-19 pandemic serves as a stark reminder of the need for businesses to develop resilient SCs to maintain sustainability and competitiveness in the face of large disruptions (Ivanov & Dolgui, 2020; Rahman et al., 2022). Moreover, major players in SCs should anticipate, prepare for, and understand the impact of disruptions by quickly responding and reconfiguring resources to enhance competencies and adapt to consequences (Ivanov et al., 2017; Moosavi et al., 2022).

Since late 2019, the COVID-19 pandemic has brought SC risk and resilience to the forefront of attention (Ferguson & Drake, 2021). Unlike natural disasters, the pandemic simultaneously disrupted supply and demand, affecting manufacturing, distribution centers, logistics, and markets (Ivanov, 2020). Major automakers, facing staff reductions and sales declines, have felt the impact on their SCs (Ivanov & Dolgui, 2020). Jordan is no exception; dealership sales have declined substantially since the COVID-19 pandemic (ElBehairy et al., 2022). Numerous studies have provided strategies to mitigate the impact of COVID-19 (Belhadi et al., 2021), recover from the pandemic (Paul & Chowdhury, 2021), and prepare for future pandemics in response to SC vulnerabilities (Moosavi et al., 2022). The unprecedented nature of COVID-19 highlights the need for enhanced SC risk research to facilitate a more organized and proactive response to disruptions (Soares et al., 2021). However, few studies have identified major SC risks for the automotive industry. Furthermore, no studies have classified resilience strategies as proactive or reactive and investigated their impact on automotive dealer performance simultaneously, which represents an enormous gap in the automotive SC literature.

Thus, the purpose of this study is to answer the following research questions: What are the major SC risks that affect dealers' performance in the automotive SC, and what is the possible moderating impact of resilience strategies on this association? and how resilience strategies can reduce SC risk while indirectly ensuring business continuity and minimizing negative environmental impacts. To be more specific, this study has four distinct objectives. First, we identify the various types of SC risk that emerged in the automotive industry during the COVID-19 pandemic. The second goal is to determine the automotive SC's resilience strategies (proactive and reactive) in the wake of the COVID-19 outbreak. Third, we assess the impact of all types of SC risk on car dealers' operational outcomes. Finally, we examine how resilience strategies interact with SC risks to moderate their impact on how well car dealerships function.

In this study, a quantitative methodology is employed, which uses structural equation modeling (SEM). This approach involves collecting data through surveys distributed to various managerial positions in Jordan's automotive industry. SEM is used to investigate the relationships among different risk factors, resilience strategies, and their impact on dealers' performance. The results include statistically validated models that identify the most effective resilience strategies, their direct and indirect effects on dealers' performance, and recommendations for putting these strategies into practice to mitigate SC risk. This study contributes to theoretical knowledge by integrating SC risk and resilience strategies in the context of the automotive SC. This study fills a critical gap in the literature by comprehensively identifying major SC risks and understanding effective proactive and reactive resilience strategies specific to this sector. Practically, this study provides industry stakeholders with actionable insights and tools to improve SC resilience, ultimately leading to more robust and environmentally friendly SC operations.

The paper is divided into several parts. Section 2 presents the hypothesis development via prior studies on the most papers related to the study's objectives in the context of stakeholder theory. Section 3 details the methodology used for data analysis. Section 4 presents the results for supply chain risk in the automotive industry. Conclusions along with limitations and future directions are presented in the last section of this paper.

2. Literature review

2.1 Stakeholder theory (theoretical perspective)

Stakeholder theory provides a comprehensive framework for interpreting the relationships between various entities involved in a business environment (Freeman, 1984). Within the automotive industry, stakeholders comprise a wide range of individuals and organizations, including manufacturers, suppliers, dealers, and customers. This theoretical perspective is extremely beneficial for examining the variety of risks that the automotive SC faces, which in turn impact the financial viability of automobile dealers (Siems et al., 2023). This section examines the incorporation of stakeholder theory into the conceptual framework that investigates four key types of risk in the automotive supply chain: supply, demand, production, and logistics/transportation. In addition, we provide two resilience strategies, namely, reactive and proactive, as moderators, which impact the relationship between these risks and the performance of automobile dealers. Moreover, stakeholder theory argues that an organization should consider the interests and expectations of all its stakeholders, recognizing their influence on the company's success (Freeman, 1984; Lechler et al., 2020). The automotive green SC encompasses various stakeholders, such as manufacturers, suppliers, dealers, customers, and regulatory entities. Every entity has a vital function in determining the overall resilience and performance of the SC (Lechler et al., 2020).

Supply risks arise from uncertainty over the availability and dependability of the raw materials and components necessary for vehicle manufacturing. Stakeholder theory highlights the importance of manufacturers and suppliers working together to establish a reliable supply chain. In terms of demand risk, the automotive industry is significantly impacted by market demand, which can vary due to economic conditions, consumer preferences, or geopolitical events. Recognizing the impact of customers as stakeholders, this approach emphasizes the need for dealers to understand and respond to evolving market demands. Additionally, production risks encompass challenges associated with the manufacturing process, such as interruptions in production lines, technological failure, and worker issues. Stakeholder theory promotes collaboration between manufacturers and dealers to improve production efficiency and reliability. Logistics and transportation risks pertain to the timely delivery of automobiles to dealerships. The importance of a well-coordinated logistics network is emphasized by this part of the model, which takes into account the involvement of green transportation stakeholders.

To address the complicated nature of these risks, the model incorporates two resilience strategies as moderators: reactive and proactive. Reactive strategies focus on addressing unforeseen disruptions. A reactive approach entails rapidly responding to minimize the consequences. Stakeholders, especially dealers, must establish flexible ways to quickly recover from SC interruptions, guaranteeing minimal interruption to operations. Proactive strategies involve the anticipation of future risks and the implementation of precautionary actions. Manufacturers and dealers should work together to invest in strong risk management techniques to strengthen the SC against potential uncertainties in the future.

Stakeholder theory is the most suitable framework for studying SC risk and resilience in the automotive industry because its comprehensive approach includes both internal and external factors. Unlike the resource-based view (RBV) and dynamic capabilities, which focus on internal resources and adaptability, respectively, stakeholder theory considers the interests of all stakeholders—customers, suppliers, employees, investors, communities, and the environment. This holistic perspective ensures that sustainable practices and long-term thinking are integral to decision-making. By addressing the concerns of various stakeholders, stakeholder theory enhances risk management and supply chain resilience, leading to improved overall performance and sustainability (Kayikci et al., 2022).

Therefore, understanding the role of these resilience strategies within the framework of stakeholder theory is crucial. Automotive dealers must possess the capacity to effectively manage SC risks, as this is crucial not only for their own operational success but also for the wider network of stakeholders involved. Suppliers, manufacturers, and customers rely on robust dealers to provide a consistent supply of products and services (Lechler et al., 2020; Siems et al., 2023). Therefore, an automotive green supply chain's performance relies on the combined ability of its stakeholders, such as dealers, to efficiently handle and reduce the inherent risks inside the system (Lechler et al., 2020). Stakeholder theory is a useful framework for understanding the complex linkages and mutual dependency (Freeman, 1984) that characterize the automotive SC and the strategies used to improve its resilience (Siems et al., 2023).

<<**Figure 1**: Conceptual Framework>>

2.2 Hypothesis development

2.3 Effects of supply chain risk on the automotive industry

In logistics, dealers play a crucial role in the SC near consumers, facing pressure for timely goods provision (M. S. Kumar et al., 2020; Paul, 2020). Automotive dealerships influence vehicle purchases with detailed information (Kamble et al., 2021). A company's strengths include proximity to customers, fostering strong relationships, gaining discounts, and maintaining a diverse fleet (Fassnacht et al., 2011; Kamble et al., 2021). The company efficiently handles cleaning and repairs through existing personnel (Kamble et al., 2021).

Modern green SCs are complex with members in diverse countries and face varied regulations and logistics systems (Gao et al., 2021). Risks to one member can lead to the entire chain's collapse, necessitating comprehensive restructuring (Gao et al., 2021). The global automotive industry, which relies on just-in-time operations, faces susceptibility to diseases, natural disasters, and geopolitical crises (Muhammad et al., 2022). The automotive industry relies heavily on just-in-time operations, limiting inventory to a maximum of 30 days. The pandemic has led to widespread closures and lockdowns of factories and suppliers, resulting in extended periods of unavailability for inventories and backup capacity (Ivanov & Dolgui, 2020). This pandemic has affected the automotive SC in terms of supply, production, demand, and logistics.

Global lockdowns aimed at controlling the virus have disrupted suppliers' ability to deliver products on time, impacting manufacturers' SCs (Chowdhury et al., 2021; Ivanov & Dolgui, 2020). Prior to the COVID-19 pandemic, major automakers heavily relied on China to supply 30%–60% of its components, but trade tensions and the U.S.–China tariff war prompted a shift in interest toward domestic production (Ishida, 2020).

Wuhan, China, the epicenter of COVID-19, has played a crucial role in autocomponent production for companies such as Volkswagen, General Motors, Hyundai, and Toyota (Belhadi et al., 2021). Plant closures in Wuhan led key suppliers to inform global clients of delivery disruptions (S. Kumar & Managi, 2020; A. Sharma et al., 2020). The automotive green SC faced disruptions due to overreliance on global outsourcing, particularly with 80% of automotive components sourced from China (Muhammad et al., 2022). The pandemic's impact has extended to industries such as automobiles, electronics, and pharmaceuticals, which are heavily dependent on China as a global SC partner (Belhadi et al., 2021).

After the Wuhan outbreak, global automakers struggled with component supply and manufacturing facility production, which affected European, U.S., Indian, and South American automakers (Ishida, 2020; Pató & Herczeg, 2020). Fiat Chrysler and Hyundai experienced production stoppages due to part shortages, and major automakers faced shutdowns globally (Haren & Simchi-Levi, 2020; Xu et al., 2020). Therefore, global autoproduction is predicted to decline by 13% as a result of these problems (Baker McKenzie, 2020).

The complexity of automotive upstream SCs, with numerous global suppliers, contributed to industry challenges during the pandemic (Muhammad et al., 2022). Global economic spillovers and the closure of China's international auto parts suppliers have made the automotive SC particularly vulnerable (Butt, 2021a; Ishida, 2020). Moreover, COVID-19 measures, including aircraft and port limitations, personnel isolation, and production suspensions, have led to a "chips shortage" in the automotive industry (Wu et al., 2021). The ongoing pandemic, geopolitical sensitivity, and trade frictions may continue to disrupt the global automotive sector (Wu et al., 2021).

Production disruption results from supplier failure (Paul & Chowdhury, 2021). To adapt to social distancing, many companies have adopted reduced office hours and alternative workdays, leading to diminished production capacity and a workforce shortage (Gunessee & Subramanian, 2020). Limited factory activities have also made machinery and capital assets obsolete (Dente & Hashimoto, 2020). Manufacturing in the automotive SC has been disrupted by locked-down workers during the COVID-19 epidemic (Muhammad et al., 2022).

Additionally, the automotive SC's production interruption is linked to decreased purchasing and customer demand due to pandemic-related material shortages, causing an economic shock (Pató & Herczeg, 2020). This economic impact has compelled companies to suspend or halt production. Suspending production due to COVID-19 has decreased demand for certain products, affecting cash flow and leading to price increases (Butt, 2021a).

From a demand side perspective, the COVID-19 pandemic has altered consumer purchasing patterns; consumers have shifted toward essential items, increasing demand for some goods but decreasing demand for nonessential goods such as automobiles (Mollenkopf et al., 2021; Paul & Chowdhury, 2020). Panic buying caused by changing preferences disrupted consumption patterns, leading to a decrease in overall demand (Butt, 2021a). Delivery delays in both online and traditional channels, as highlighted by (Ivanov & Das, 2020), further complicate the situation for the automobile industry, introducing uncertainty into SCs and hindering forecasting and decision-making (Gunessee & Subramanian, 2020).

China, a key provider of intermediate inputs for foreign manufacturing, has experienced a direct effect on the car industry's output and exports due to the pandemic (Xu et al., 2020). Just-in-time manufacturing and restricted stockpiles contributed to shortages that hindered production and exports for many automobile businesses. Retail stores, including automotive dealers, face issues such as production stoppages, delayed deliveries, and financial concerns, leading to trust issues in the SC (Ivanov, 2022). The adoption of "no-touch deliveries" became a new operational norm for retailers (Paul et al., 2021). Finally, the automotive SC grappled with supply shortages, delays, and uncertain demand during the COVID-19 pandemic. Suppliers face the challenges of being unresponsive and inflexible (Paul et al., 2021). The absence of government support and incentives, coupled with the lack of cost-sharing and loss contracts, poses problems for automotive SC members (Ivanov, 2022). The epidemic significantly impacted the demand within the automotive SC.

COVID-19-induced restrictions and shutdowns also affect transportation capacity and pricing, particularly in the automotive sector (Pató & Herczeg, 2020). Increased costs and prioritized transit for essential goods led to material shortages in factories that rely on just-in-time principles, exacerbating challenges for the automotive green SC (Paul et al., 2021).

Prior studies revealed a lack of a thorough examination of the strategic responses and adaptations made by automotive supply chains to improve their resilience after the COVID-19 pandemic. The current body of literature extensively addresses the various disruptions caused by the pandemic, such as supply shortages, production stoppages, and shifts in consumer demand. However, there is a lack of research on long-term strategies and the best practices that automotive supply chains can implement to reduce future risks. Research that specifically focuses on all types of SC risk is needed. This study aims to create a stronger and more flexible automotive SC that can effectively handle current and future global disruptions by identifying all types of SC risk in the automotive industry.

2.4 Automotive dealers' performance

Distribution centers are crucial for optimizing green SCs in terms of cost, quality, and time, with a focus on the connection, retrieval, and storage of goods. Disruptions in these centers, as noted by (Paul et al., 2021), negatively impact key performance metrics such as return on sales, profit, stock return, brand image, employment, customer safety, and overall SC performance (Paul & Chowdhury, 2021).

Before the COVID-19 pandemic, automotive dealerships faced a challenging business landscape, prompting business managers to assess their process models and strategies (Inampudi et al., 2019). Challenges in customer retention and business performance arose from the dynamic nature of car technologies and shifts within the automotive sector (Mohr et al., 2016). Nissan, a prominent Japanese automobile company, announced on March 23, 2020, its decision to temporarily halt operations in Africa, the Middle East, and India due to the COVID-19 pandemic. This decision, aligned with national authorities' recommendations, aimed to prioritize the well-being and safety of the company's personnel, clientele, and local communities, as highlighted by (Xu et al., 2020).

The performance of automotive dealership, which is heavily influenced by vehicle sales and aftersales service provisions (Fassnacht et al., 2011), faced a significant setback during the COVID-19 pandemic. According to (Zulkifli et al., 2020), new vehicle production ceased, and dealerships worldwide closed in 2020, resulting in a complete absence of vehicle sales and a substantial decline in revenue.

2.5 Resilience strategies in the automotive supply chain

Supply chain resilience (SCR) is the ability of an SC to prevent, absorb, and recover from unforeseen disturbances (Hendry et al., 2019). SCR recovery postdisruption is distinct (Golan et al., 2020), requiring cross-domain evaluation for policy design that enhances the system's ability to plan, absorb stress, recover, and adapt to future stressors (Menoni & Schwarze, 2020). Understanding reactive capability and postdisruption activities is crucial for SCR resilience and management (Ponomarov & Holcomb, 2009).

Studies suggest strategies for mitigating the impact of the COVID-19 pandemic on SCs, emphasizing the need for better SCR research due to the susceptibility of the virus (Chowdhury et al., 2021). The lack of crucial information hampers responses, highlighting the importance of improved SCR research (Soares et al., 2021).

The automobile industry, which has historically been influential in managing SC disruptions, faces challenges due to COVID-19 (Belhadi et al., 2021; Muhammad et al., 2022). With over 20,000 parts in a car and a complex supplier network, proactive and reactive resilience strategies were adopted during and after the pandemic (Muhammad et al., 2022). Automakers worldwide must quickly devise proactive and reactive resilience strategies to restructure their supply networks for recovery (Muhammad et al., 2022).

Proactive strategies aim to reduce the likelihood of risk events by managing and mitigating risks before they occur (Paul et al., 2021). The implementation of these strategies, particularly in the face of major disruptions such as the COVID-19 pandemic, can significantly enhance a firm's operational resilience (Kazancoglu et al., 2023; Tang, 2006). The automotive SC, for example, has adopted proactive measures such as centralization to leverage closed-integral setups for increased resilience (Ishida, 2020). In response to the pandemic's impact, transitioning from a decentralized to a centralized management model is recommended to maximize the proximity between suppliers and production sites (Ishida, 2020). However, the challenge lies in the complexity of vehicle manufacturing, which requires numerous components with varying lead times, making return to a centralized SC system challenging (Ishida, 2020). To address this, original equipment manufacturers (OEMs) and other stakeholders are developing alternative, flexible SCs to reduce dependence on a single source (Ishida, 2020). This involves considering the procurement, consolidation, and transportation of goods within strategically centralized management systems and reassessing the implementation of regional logistics hubs (Ishida, 2020). Studies support the effectiveness of implementing localized supply sources as a strategy to mitigate COVID-19 risk in the automobile industry (Belhadi et al., 2021).

Butt, (2021a) suggested proactive strategies for the automotive industry during the COVID-19 pandemic. This includes agile production methods that prioritize essential items during material shortages. Automotive companies must understand their Tier 1 suppliers' purchase orders comprehensively (Butt, 2021a).

Integrated SC risk management is crucial, emphasizing collaboration between OEMs and SC partners, with the focal firm leading risk management efforts from a holistic perspective (Belhadi et al., 2021). Emergency sourcing, involving alternative supply sources during disruptions, is essential for overcoming supplier outages (Sudan & Taggar, 2022). During the pandemic, academics proposed technical solutions, such as leveraging Industry 4.0, digital SCs, and mobile service operations for home delivery (Choi, 2020; Chowdhury et al., 2021). The creation of new technologies is deemed essential for transformative SC evolution (Muhammad et al., 2022).

The automotive industry is exploring Industry 4.0 technologies for digital SC transformation (Belhadi et al., 2021; Muhammad et al., 2022). Industry 4.0, denoting the fourth industrial revolution, originated in 2011 to increase German manufacturing competitiveness (Schwab, 2017).

Industry 4.0, which focuses on technological advancements and digitalization, integrates key technologies such as the Internet of Things, cyber-physical systems, cloud computing, and big data (Soares et al., 2021). This integration provides system benefits such as flexibility, visibility, traceability, and reliability (Paul et al., 2021), addressing green SC challenges for retailers. The inclusion of blockchain, artificial intelligence, and demand forecasting in Industry 4.0 can effectively manage SC disruptions (Butt, 2021b; M. Sharma et al., 2022).

A study explored the application of Industry 4.0 to address insufficient autocomponent supply in the automotive industry's upstream SC. It emphasized digitizing procurement processes through information and communication technologies

(ICTs) and internet-based automated decision-making systems (Muhammad et al., 2022). This integration aims to increase value for customers and organizations (Nicoletti, 2020). The automotive sector can leverage Industry 4.0 technologies to address SC issues.

This study recommends integrating additive manufacturing (AM) technology in the automotive green SC during procurement to strengthen the network. This involves sharing design files between suppliers and manufacturers, producing components on the basis of demand (Muhammad et al., 2022). (Soares et al., 2021) propose a methodology to assess Industry 4.0 adoption in the automotive OEM sector postpandemic, aiding in SC resilience. SC simulation, demonstrated by (Belhadi et al., 2021), addresses uncertainties effectively.

Furthermore, SC automation optimizes physical and information flow, reducing interdependence among firms (Belhadi et al., 2021). Technological advancements, including digital twins, blockchain, and the Internet of Things, offer accuracy, transparency, and connectivity, improving resilience (Belhadi et al., 2021). Blockchain enhances confidence between consumers and retailers, increasing SC transparency (Jum'a, 2023; Soares et al., 2021). Big Data Analytics (BDA) in SC information systems enable real-time data processing, facilitating timely decision-making (Belhadi et al., 2021).

Sudan and Taggar, (2022) propose a proactive strategy, "SC risk analytics," which involves analyzing scenarios to gain intelligence on potential future events, enhancing SC risk management. Mitigation in the automotive SC requires information sharing among members, addressing flexibility issues. Information sharing and analysis can provide timely updates on operations, helping mitigate pandemic challenges (Soares et al., 2021). In addition, (Zulkifli et al., 2020) suggest leveraging connected systems, big data, and intelligent systems to address disruptions and adopt a proactive strategy. Establishing a command center enables effective coordination, adjustment of the risk response, and maintenance of adaptability. Additionally, a comprehensive training program for employees is crucial to address challenges posed by COVID-19 or similar circumstances (Paul et al., 2021).

Reactive strategies are crucial for managing risks in unpredictable events, such as disease outbreaks, earthquakes, and terrorist attacks, beyond businesses' control (Paul et al., 2021). The implementation of reactive strategies, as suggested by (Zhu et al., 2017), aims to minimize additional costs related to recovery. Resilience, defined by (Aslam et al., 2020), involves the capacity to recover reactively after disruptive events.

The automotive SC responded to the COVID-19 pandemic with various reactive strategies, such as SC collaboration, recommended in the sector (Belhadi et al., 2021). However, classification as reactive or proactive depends on the implementation timing and purpose. Collaborative efforts at each SC level help anticipate, forecast, and mitigate risks collectively (Zhu et al., 2017). SC collaboration enhances resilience through data exchange, accessibility, and agility to respond to disruptions (Sudan & Taggar, 2022).

Establishing strong collaboration within automotive green SCs is crucial because of extended product delivery times, and only some suppliers meet the necessary standards (Pató & Herczeg, 2020). Moreover, implementing collaborative planning and forecasting enhances SC visibility in the automotive sector, integrating firms and sharing intelligence about potential disruptions (Sudan & Taggar, 2022). This strategy facilitates coordinated procurement, distribution, and production planning during disruptions, aiding distribution centers in mitigating the effects of the COVID-19 pandemic (Sudan & Taggar, 2022).

Collaborative planning between automotive original equipment manufacturers (OEMs) and suppliers, as suggested by (Zouari et al., 2021), facilitates the development of business processes to proactively identify, monitor, and mitigate disruptions. Another observed strategy is "contingency planning" (Belhadi et al., 2021), which involves proactive anticipation of events and measures to address SC risks before they occur. Implementation includes forecasting, monitoring early warning signals, and utilizing backup suppliers (Hohenstein et al., 2015).

During the COVID-19 pandemic, adjusting inventory policies among automotive distributors can effectively mitigate SC risk. However, this poses challenges for many firms lacking comparable inventory buffers because of the impact of the virus (Butt, 2021a). Distribution centers, as proposed by (Ivanov, 2020), can mitigate disruptions through inventory inflation and alternative route utilization. (A. Sharma et al., 2020) recommend decreased inventory levels across SCs to alleviate the repercussions of COVID-19, presenting a challenge in managing inventory levels during the pandemic.

In the automotive SC, a reactive approach was adopted by numerous participants, who acquired substantial portions of suppliers' stock for pandemic preparedness (Pató & Herczeg, 2020). The bullwhip effect of coronavirus has unpredictably impacted demand, significantly affecting various SC stakeholders (Pató & Herczeg, 2020). Effective inventory management strategies such as safety stock, strategic stock, and prepositioning, according to (Sudan & Taggar, 2022), can mitigate short-term disruptions. Safety stock acts as insurance against unforeseen delays, serving as a reliable buffer to prevent stockouts and ensure uninterrupted SC operations during the pandemic (Sudan & Taggar, 2022).

Automotive companies must consistently prioritize factors such as workforce quality, service refinement, and innovation to meet customer expectations, fostering loyalty and robust relationships (Butt, 2021b). Distributors and suppliers in the automotive SC should understand customer demands, especially amid inventory shortages. Establishing agreements and opening communication channels with customers is vital for addressing COVID-19-induced inventory challenges (Butt, 2021b). Resilient communication channels with suppliers are crucial for comprehensive risk mitigation discussions. (Wu et al., 2021) suggest that China enhances international collaboration to manage chip supply disruptions, emphasizing strategic planning and increasing semiconductor chip localization. Enterprises should adopt a multifaceted approach to address the ongoing "chips shortage" crisis.

It is imperative for automotive market participants to prioritize workforce well-being. In challenging circumstances, a comprehensive strategy should be formulated to retain employees while considering remote work strategies (Zulkifli et al., 2020). Safety measures for the workforce are crucial, as emphasized by (Paul et al., 2021). (Hendrata et al., 2021) proposed enhancing the marketing information system as a resilience strategy in the automotive industry during the COVID-19 era. This is essential for maintaining customer loyalty and ensuring company survival. Firms' responses to disruptions vary on the basis of financial stability (Ozdemir et al., 2022). OEMs, with greater resources, can construct efficient systems, whereas SMEs are more susceptible to adverse consequences (Ozdemir et al., 2022). There is a shift from reactive strategies to proactive strategies, driven by the recognition of the potential of digital technologies, such as cloud computing and blockchain, to enhance SCR (Gao et al., 2021).

The gap in the existing body of literature on SCR lies in the lack of integration between proactive and reactive strategies. This indicates the necessity for more inclusive frameworks that successfully combine these approaches. Prior studies have typically investigated proactive and reactive strategies as separate classifications. There is a shortage of comprehensive models that demonstrate how organizations can be impacted by these strategies, resulting in a more robust and flexible SC that can withstand both expected and unexpected disruptions.

The following hypotheses were formulated on the basis of the previous discussion of the types of SC risk and the main types of resilience strategies:

H1: Supply risk has a significant effect on dealers' performance in the automotive industry.

H2: Production risk has a significant effect on dealers' performance in the automotive industry.

H3: Demand risk has a significant effect on dealers' performance in the automotive industry.

H4: There is a significant impact of logistics and transportation risks on dealers' performance in the automotive industry.

H5: Proactive resilience strategies have a significant moderating effect on the relationship between automotive dealer risk and dealers' performance in the automotive industry.

H6: Reactive resilience strategies have a significant moderating effect on the relationship between automotive dealer risk and dealer performance in the automotive industry.

3. Materials and methods

3.1 Sampling and data collection

The main steps in sampling and data collection start with participant selection, which involves identifying and recruiting individuals or groups through methods such as random, purposive, or convenience sampling to create a sample that represents the study's population or includes stakeholders with relevant knowledge. The survey distribution follows, disseminating surveys through email, online platforms, or in person, accommodating participants' schedules to maximize response rates. The data collection process involves gathering accurate, reliable, and valid data through surveys or other methods, preparing the data for analysis to answer research questions and achieve study objectives effectively.

Therefore, the participants who took part in this study were employed in diverse managerial positions within the automotive industry in Jordan. The participants in the study provided primary data by completing a structured questionnaire. The researchers employed a purposive sampling method to select the sample for the study. This particular methodology enables researchers to identify the primary participants who are engaging in the survey.

The research focused on department managers and senior-level personnel within automotive dealerships in Jordan, including plant managers, purchasing managers, operations managers, logistics managers, sales managers, development managers, and marketing managers. The chosen cohort of managers is considered a suitable and distinct group because of their direct or indirect involvement in risk management and workflow preservation. Consequently, the respondents possess the ability to offer valid responses to the research objectives set forth.

The questionnaire was disseminated online through a hyperlink as a result of the restricted sample size and the demographic attributes of the participants, who were identified as managers and experts with demanding schedules. Therefore, this enhances respondents' convenience in completing the questionnaire at their preferred time, thereby potentially increasing the response rate. A total of 400 emails were distributed, of which 157 were deemed usable, indicating a response rate of 39.3%. The data were gathered during the period spanning from June to December 2022.

3.2 Measurement scale

The scale items used in this study were derived from previous studies, as evidenced by the information presented in Tables 1 and 2. Moreover, the dealers' performance was derived from (Belhadi et al., 2021) and (Zulkifli et al., 2020). The questionnaire was divided into two sections, with the first encompassing a range of inquiries pertaining to the demographic characteristics of the respondents. Moreover, participants were requested to indicate their degree of agreement or disagreement on a 5-point Likert scale in relation to the research constructs explored in the second section. These constructs encompassed four distinct categories of SC risk, as well as proactive and reactive resilience strategies.

3.3 Sample characteristics

The participants' demographic variables, including education, professional title, and automotive industry experience, were analyzed. Table 1 reveals that 58% had a bachelor's degree, 33.1% held a graduate degree, and 8.9% had a college degree. With respect to occupational roles, 29.9% were in senior positions, 29.3% were in mid-level roles, 14.0% were in junior positions, and 24.2% were consultants. Notably, senior and consultant positions comprised more than 50% of the sample. The survey targeted automotive industry managers and experts. In terms of experience, 43.3% had 11--20 years, 27.4% had 5--10 years, 7.6% had less than five years, and 29.3% had more than 20 years.

<<**Table 1**: Demographics>>

4. Results & Discussion

The chosen methodology, which is quantitative and relies on SEM, is suitable for addressing the research questions, as it allows for a comprehensive analysis of the complex relationships between various SC risk factors, resilience strategies, and their impact on dealers' performance. By collecting data through surveys distributed to managerial positions in Jordan's automotive industry, SEM enables the identification and measurement of latent variables and the examination of both direct and indirect effects within the SC context. This approach facilitates the development of statistically validated models that reveal the most effective resilience strategies and their influence on performance outcomes and provides actionable recommendations for mitigating SC risk. The robust statistical capabilities of SEM make it ideal for uncovering the intricate dynamics of SC resilience and performance.

The data were subjected to analysis via descriptive statistics in SPSS version 27. Furthermore, the researchers employed structural equation modeling (SEM) via Smart PLS software version 3. The evaluation of the hypotheses proposed in the study required an assessment of both the measurement model and the structural model.

4.1 Descriptive analysis

The descriptive statistics included the mean and standard deviation, as shown in Table 2.

<<**Table 2**: Descriptive Statistics>>

According to Table 2, the highest supply risk dimension is chip shortage (mean = 4.166), followed by a lack of supply of auto components in the automotive SC (mean = 4.102), and finally, the automotive industry's overdependence on global outsourcing for production from China has the lowest score (mean = 4.089). In terms of production risk, automotive suppliers used the just-in-time concept on average; thus, few retailers maintained extra inventory before the pandemic (mean = 4.159), whereas delays in automobile businesses' research and development had the lowest score (mean = 3.803). In terms of demand risk, the lack of government support has the greatest average score (mean = 4.197), whereas the pattern of customers' purchasing behavior has the lowest average score (mean = 3.236). Finally, in terms of logistics and transportation risks, it is clear that nonflexible transportation routes have the highest average score (mean = 3.949), whereas high freight charges have the lowest average score (mean = 3.51) because these charges are reflected in the selling price to customers. Figure 5 depicts the percentage of respondents who believed that these four types of risk had an impact on the automotive industry and dealer performance.

<<**Figure 2**: The mean scores of the effects of risk type >>

Figure 2 shows that demand risk received the highest score (mean=4.13), followed by production risk (mean=4.12), logistics and transportation risk (mean=4.08), and supply risk (mean=3.91).

4.2 Structural equation modeling

To ensure the validity and reliability of the data collected, the survey was designed on the basis of a thorough review of literature, ensuring that it accurately captures all relevant constructs. The questions were derived from validated scales used in previous research. The survey was equipped with multiple items for each construct to enhance internal consistency. In the data analysis phase, confirmatory factor analysis (CFA) was performed to verify the measurement model and ensure that the constructs had good convergent and discriminant validity. The reliability of the data was assessed via Cronbach’s alpha for each construct to gauge internal consistency, along with composite reliability (CR) and average variance extracted (AVE) to further confirm the reliability of the constructs.

Therefore, partial least squares modeling of structural equations was performed via the SmartPLS program (Ringle et al., 2015). The conceptual model was evaluated twice. The first phase involved evaluating the measurement model to ascertain its validity and reliability. In the second step, the structural model was assessed to verify the suggested theories.

The internal consistency of the latent variables was examined via Cronbach's alpha. Table 3 shows a range of Cronbach's alpha values from 0.709--0.843, which is higher than the recommended threshold of >0.70 (Hair et al., 2019). The factor loadings were much higher than the recommended level (>0.60), indicating that the model had sufficient convergent validity (Hair et al., 2019). Every item whose value was less than 0.6 was eliminated. Finally, the results revealed that the average variance extracted (AVE) values were greater than the permissible threshold of 0.50.

<<**Table 3**: Factor Analysis>>

To support the fit between the hypothesized model and the data, the model fit was verified via SRMR statistics with a cutoff value of less than 0.08 (Hair et al., 2019). The data indicate that the SRMR value is 0.054. Figure 6 depicts the model fit.

<<**Figure 3**: PLS–SEM results >>

(Fornell & Larcker, (1981) criteria were used to establish discriminant validity. For sufficient discriminant validity, they suggested that the square root of the AVE be greater than the interconstruct correlation coefficients. Table 4 shows the diagonal elements that are the square root of the AVE and are greater than the off-diagonal elements that represent correlation coefficients.

<<**Table 4**: Discriminant validity>>

4.3 Results of the structural model

To determine the results of the four key hypotheses concerning the impact of green SC risk on dealer performance in Jordan's automotive industry. With 5000 subsamples, the bootstrapping approach was employed to calculate coefficient estimates. Table 5 shows the estimation results, including beta values, t statistics, p values, and hypothesis acceptance/rejection.

<<**Table 5**: SEM results>>

The structural model results showed that all of the links were significant, providing strong evidence for all of the hypotheses to be validated. Among the direct effects, demand risk had the greatest impact on dealer performance (beta = 0.682). Figure 4 depicts the model fit analysis as well as the presence of moderating factors, which are reactive and proactive strategies.

<<**Figure 4**: SEM moderating effect >>

Table 6 presents the estimation findings, along with beta values, t statistics, p values, and whether the hypotheses were accepted or rejected.

<<Table 6: SEM moderating results>>

The relationship between green SC risk and dealer performance was shown to be significantly moderated only by proactive initiatives (beta = 0.237, p 0.05). Conversely, the association between SC risk and dealer performance was moderated by reactive methods. The moderation effect, however, was not statistically significant.

5. Discussion

The findings from the examination of risk dimensions on automotive dealership performance in Jordan indicate that all four dimensions—demand risk, logistics and transportation risk, production risk, and supply risk—have a statistically significant effect on dealers' performance, with demand risk exerting the greatest impact, followed by logistics and transportation risk, production risk, and supply risk. This sequence highlights the critical need for automotive dealers to prioritize demand management and logistics optimization to sustain performance amidst disruptions.

These results are consistent with those of a study conducted by (Xu et al., 2020), which demonstrated that COVID-19 had a significant impact on both local and global SCs, unlike previous natural or man-made disasters or infectious pandemics. COVID-19 disrupted SCs at every stage, from the sources of supply to the ultimate customers, and, according to (Butt, 2021a), the current pandemic has been found to have a significant effect on multiple sectors within the SC, including buyers, distributors, and suppliers.

Furthermore, the findings presented here align with those of (Sun, 2022), who highlighted the significant decline in automobile sales as a result of the pandemic. This decline has led automotive dealers to confront substantial inventory pressure and challenges in capital turnover. Consequently, the decrease in automobile sales and the increase in operating costs have contributed to a continuous increase in financial pressure for dealers. Furthermore, the immediate drop in demand for automobiles has significantly affected dealerships, whose success relies heavily on vehicle sales and the provision of aftersales services (Fassnacht et al., 2011).

Additionally, this study assessed the impact of proactive and reactive resilience strategies as moderating factors on the relationship between risk dimensions and dealers' performance in the automotive industry in Jordan via partial least squares-structural equation modeling (PLS-SEM). The findings revealed that proactive strategies significantly enhance the relationship between risk and performance, underscoring the importance of anticipation and preparation for potential disruptions. However, reactive resilience strategies did not have a significant moderating effect, suggesting that immediate response measures alone are insufficient for maintaining performance under risk conditions.

These findings align with those of the study conducted by (Gao et al., 2021), which identified two overarching categories of strategies for enhancing the resilience of automotive SCs: proactive strategies and reactive strategies. Proactive strategies are designed to anticipate and prepare for potential disruptions, whereas reactive strategies focus on recovering and restoring the functionality of a green SC following a disruption.

Nevertheless, the lack of reactive strategies as a moderating factor in the association between the risks faced by automotive dealers and their performance aligns with the findings of (Ozdemir et al., 2022). Their study suggested that well-established sectors such as the automotive industry tend to adopt proactive strategies over reactive strategies, whereas reactive strategies are more commonly employed by SMEs. Moreover, it is worth noting that there has been a relatively lower emphasis on reactive strategies (Gao et al., 2021). This is due to the growing interest in digital technologies, such as cloud computing and blockchain, which have the potential to increase green SC resilience by improving visibility, anticipation, and adaptability within the automotive SC (Gao et al., 2021).

The alignment of these findings with the literature underscores the robustness of the study and provides a comprehensive understanding of the dynamics among risk factors, resilience strategies, and performance in the automotive industry. The insights gained from this study offer valuable recommendations for both theory and practice, emphasizing the need for proactive resilience measures and the integration of advanced digital technologies to sustain and enhance green supply chain performance amidst ongoing and future disruptions.

5.1 Theoretical implications

This paper makes a valuable contribution to the existing body of literature on automotive SC risk and resilience in light of the COVID-19 pandemic. This paper makes several contributions. This study presents a conceptual framework that delineates the primary dimensions of risk and resilience strategies. Moreover, we developed a framework to fill a gap in the literature by providing a thorough conceptual paradigm for comprehending risks and resilience in the automotive industry. The proposed framework can help researchers study or refine conceptual models.

Furthermore, this study offers empirical evidence regarding the favorable impact of supply risks, production risks, demand risks, logistics, and transportation risks on automotive dealerships in Jordan. The aforementioned contribution fills a significant gap in the academic literature on pandemic risk in developing countries, with a focus on Jordan. Additionally, it aligns with Sustainable Development Goal 9 (SDG9), which emphasizes strong infrastructure, inclusive and sustainable industrialization, and innovation. The automotive SC has implemented resilience strategies to address the problems brought about by the pandemic effectively. These strategies aim to strengthen industrial and SC infrastructure resilience. Consequently, this study offers empirical evidence regarding the advantages of proactive strategies, which can serve as a moderating factor in mitigating the adverse effects of pandemics on the performance of automotive dealerships.

5.2 Practical implications

This study has practical implications for auto dealership managers and experts. This study can help Jordanian automotive dealership managers and experts anticipate and mitigate four pandemic-related risks: supply, production, demand, and logistics. Doing so allows them to develop effective pandemic mitigation strategies. The study explored seven proactive strategies that can be used in facing such a pandemic (agile production, localization and regionalization of sourcing, emergency sourcing/alternative suppliers, integrated green SC risk management, adoption of technology, robust information sharing systems, and training programs for workers). Moreover, the study revealed twelve reactive strategies that can be used in confronting such a pandemic (SC collaboration, contingency planning, flexible route strategies, updating inventory policies, online sales, mobile services, and home delivery, understanding immediate customer demand and priorities, opening communication channels with customers, developing robust communication channels with suppliers, government support, competitive selling prices, safety measures for the workforce, and marketing information systems). This study may help experts compare Jordanian and global automotive dealership impact levels. This comparison assesses Jordan's response to the COVID-19 pandemic. The model developed in this study can help automotive dealership managers and experts. All risk dimensions and resilience strategy practices are shown in Table 2. Therefore, it can be used as a reference tool for new strategies or legislation in this field. All the SC risks were identified and classified into four categories, and proactive and reactive resilience strategies were recognized. Decision-makers can ensure sustainability by emphasizing business continuity and environmental protection as follows: Supply risks, such as an overreliance on global outsourcing and component shortages, can increase carbon emissions through long-distance transportation and the need to source materials from less sustainable suppliers. This disrupts the green SC by lowering environmental standards and sustainability practices. The proposed implication could be to develop and diversify a network of local and regional suppliers who adhere to sustainable practices. This reduces reliance on global suppliers, shortens transportation distances, and lowers carbon emissions. Establishing long-term partnerships with these suppliers can also ensure a more stable and sustainable SC. Production risks, such as lockdown-induced labor shortages and stoppages, can lead to inefficiencies, resource waste, and increased energy consumption. These disruptions may force businesses to use less environmentally friendly production methods to catch up on delays, harming the green supply chain. Decision makers can implement advanced production planning and automation technologies that improve efficiency and reduce waste. The utilization of renewable energy sources and adoption of lean manufacturing principles can help maintain production sustainability even during disruptions. This approach not only minimizes resource use but also enhances production resilience. Demand risks, such as changes in customer purchasing behavior and supply–demand imbalances, can result in overproduction or stockpiling. This leads to increased waste and resource consumption, which is detrimental to a green supply chain. Efficient demand forecasting and sustainable inventory management are critical for mitigating these risks. Thus, it is better to utilize advanced analytics and demand forecasting tools to better predict customer needs and adjust production schedules accordingly. Implementing flexible manufacturing systems that can quickly adapt to changes in demand helps avoid overproduction and waste, aligning with green SC principles. Finally, logistics and transportation risks, such as high freight charges and travel disruptions, can force businesses to use less efficient transportation modes and alternative routes, increasing carbon emissions. Inflexible routes and limited storage space exacerbate emissions while decreasing the overall efficiency and sustainability of the supply chain. Sustainable logistics practices and adaptable transportation strategies are critical for sustaining a green SC. Therefore, logistics can be optimized through the use of intermodal transportation, combining different modes of transport that are more sustainable, such as rail and sea, rather than relying solely on road and air freight. Additionally, investing in electric or hybrid vehicles for transportation can significantly reduce emissions and improve the environmental footprint of the supply chain.

5. Conclusions

This study aimed to identify a range of SC risks and develop effective resilience strategies. It also sought to measure the impact of various types of SC risk and examine how the implementation of resilience strategies can influence the relationship between supplier performance and green SC risk.

The COVID-19 pandemic has had a significant impact on automotive green SCs, and automotive dealers are individuals who have been badly impacted. Through a literature analysis, the many forms of risk affecting the automotive SC were discovered and classified into four categories: supply risk, production risk, demand risk, and logistics and transportation risk. Furthermore, the various resilience strategies used by members of the automotive SC have been observed and classified into two groups: proactive strategies and reactive strategies. The performance of automobile retailers during the COVID-19 pandemic was also evaluated. With these factors, a conceptual model was developed. The model assessed the impact of each risk type on dealer performance, as well as the moderating influence of resilience strategies on the connection between SC risk and dealer performance. This research was carried out in Jordanian car dealerships.

The influence of the four types of risk on dealer performance was examined via SEM, and the results demonstrated that supply risk, production risk, demand risk, and logistics and transportation risk substantially affected the performance of Jordanian automobile dealers. According to the findings, demand risk has the greatest influence on dealer performance in Jordan, followed by logistics and transportation risk, production risk, and finally supply risk. The effects of proactive and reactive resilience tactics as moderating factors on the link between risk dimensions and dealer performance in Jordan's automobile industry have been measured. The findings demonstrated that proactive strategies have a substantial effect on the relationship between risk and dealer performance in Jordan's automotive industry. However, the findings indicate that reactive resilience strategies have no substantial moderating influence on the relationship between automotive dealer risk and dealer performance in Jordan's automotive industry. As a result, proactive strategies may be more effective than reactive strategies in mitigating the impact of the COVID-19 epidemic on car dealers.

This study has several limitations that can be used to generate recommendations for further research. For example, this study is limited to Jordanian automobile dealerships. As a result, future studies should include other dealerships worldwide. Another drawback of this study was the difficulty in gathering data from human experts in the automotive sector; despite emails and phone calls, the response rate was lower than anticipated. As a result, future studies can collect a larger number of responses and yield more reliable results for the proposed framework. Finally, future research could look into applying the framework to other countries and manufacturing sectors.

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Table 1. Participants' demographic variables

Demographic Variable	Variable	Frequency	Percentage %
Education Level	College Degree	14	8.9%
	Bachelor Degree	91	58.0%
	Graduate Degree	52	33.1%
Job Title	Consultancy –level	38	24.2%
	Senior-level	47	29.9%
	Mid-level	46	29.3%
	Junior-level	22	14.0%
Years of Experience in Automotive Sector	Less than 5 years	12	7.6%
	5-10 years	43	27.4%
	11-20 years	68	43.3%
	21-30 years	34	21.7%
	More than 30 years	12	7.6%

Table 2. Risks in the automotive industry

No.	**Supply risks**	**Mean**	**S.D.**
1.	The overdependence of automotive industry on global outsourcing	4.089	0.80
2.	Chips shortage.	4.166	0.75
3.	Lack of supply of auto components in the global automotive industry	4.102	0.80
No.	**Production risks**	**Mean**	**S.D.**
1.	Stuck labors in lockdown affected the production	4.019	0.94
2.	Surge in prices in automotive sector	3.93	0.93
3.	Stoppage in production execution	3.981	0.87
4.	Delayed car companies' research and development plans	3.803	1.19
5.	Automotive suppliers adoption of Just In Time principle (JIT)	4.159	0.84
No.	**Demand risks**	**Mean**	**S.D.**
1.	Automotive dealers are facing a sharp drop in demand (sales)	3.344	1.01
2.	There has been a notable shift in the purchase behavior of customers, encompassing both essential and nonessential things.	3.236	1.06
3.	Lack of balance in supply and demand	3.561	0.99
4.	Lack of inventory for certain automobile types	3.561	0.94
5.	Lack of accessibility with customers	4.038	0.74
6.	Failure of on-time delivery to customers	3.834	0.88
7.	Lack of governments support	4.197	0.75
8.	Lack of information sharing between stakeholders in the supply chain	3.968	0.75
No.	**Logistics and transportation risks**	**Mean**	**S.D.**

1.	High freight charges	3.51	1.06
2.	The delays, postponements, cancellations, and obstructions due to travel restrictions and borders closing	3.65	1.11
3.	Lack of transportation for international trade	3.873	0.95
4.	Non-Flexible transportation routes	3.949	0.95
5.	Limited storage space	3.541	1.17

Table 3. Construct reliability and validity

Variable	Dimension	Code	Factor loading	AVE	Cronbach 's Alpha
Independent Variables	Supply Risks	D1.1	0.782	0.628	0.709
		D1.2	0.779		
		D1.3	0.814		
	Production Risks	D2.1	0.86	0.611	0.828
		D2.2	0.867		
		D2.3	0.683		
		D2.4	0.605		
		D2.5	0.856		
	Demand Risks	D3.1	0.785	0.516	0.843
		D3.2	0.694		
		D3.3	0.769		
		D3.4	0.782		
		D3.5	0.665		
		D3.6	0.667		
		D3.7	0.652		
		D3.8	deleted		
	Logistics and Transportation Risks	D4.1	0.69	0.592	0.838
		D4.2	0.825		
		D4.3	0.862		
		D4.4	0.701		
		D4.5	0.754		
Moderating Factor	Proactive Strategies	M1.1	0.734	0.606	0.867
		M1.2	0.786		
		M1.3	0.866		
		M1.4	0.832		
		M1.5	0.616		
		M1.6	deleted		
		M1.7	0.81		
	Reactive Strategies	M2.1	0.744	0.502	0.880
		M2.2	0.704		
		M2.3	0.743		
		M2.4	0.643		
		M2.5	0.711		
		M2.6	0.642		

		M2.7	deleted		
		M2.8	0.701		
		M2.9	0.696		
		M2.10	0.78		
		M2.11	deleted		
Dependent Variable	Dealers' Performance	D1	0.758	0.693	0.781
		D2	0.828		
		D3	0.905		

Table 4. Discriminant validity.

	ADP	Demand Risks	Logistics Risks	Proactive Strategies	Production Risks	Reactive Strategies	Supply Risks
ADP	**0.833**						
Demand Risks	0.367	**0.718**					
Logistics Risks	0.442	0.686	**0.769**				
Proactive Strategies	0.401	0.713	0.522	**0.778**			
Production Risks	0.350	0.616	0.473	0.911	**0.782**		
Reactive Strategies	0.075	0.002	0.006	0.000	0.042	**0.708**	
Supply Risks	0.397	0.465	0.394	0.466	0.457	0.018	**0.792**

Table 5. Results of the structural model

Paths	Beta	T Statistics	P Values	Results
H1: Supply Risks -> dealers' performance	0.226	6.632	0.000	Supported
H2: Production Risks -> dealers' performance	0.392	7.163	0.000	Supported
H3: Demand Risks -> dealers' performance	0.682	17.101	0.000	Supported
H4: Logistics Risks -> dealers' performance	0.639	13.478	0.000	Supported

Table 6. Results of the structural model (moderation effects)

Paths	Beta	T Statistics	P Values	Results
H5: Automotive risks ->Proactive resilience -> dealers' performance	0.237	2.589	0.012	Supported
H6: Automotive risks ->Reactive resilience -> dealers' performance	0.11	0.981	0.341	Rejected

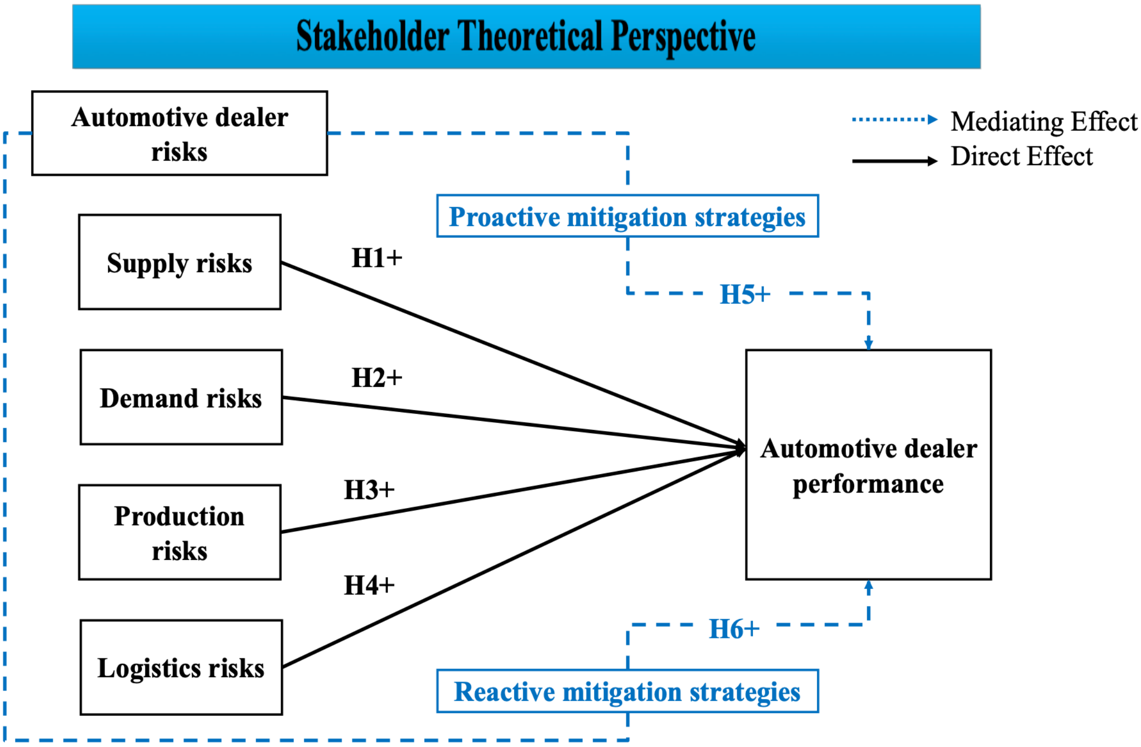

Figure 1. The conceptual framework, where "H" denotes the proposed hypothesis.

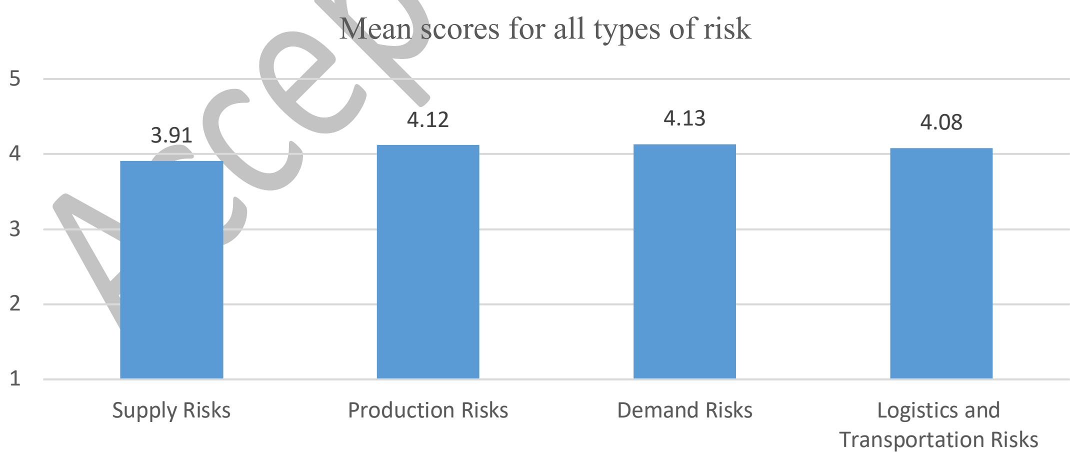

Figure 2. The mean scores of the effects of risk type.

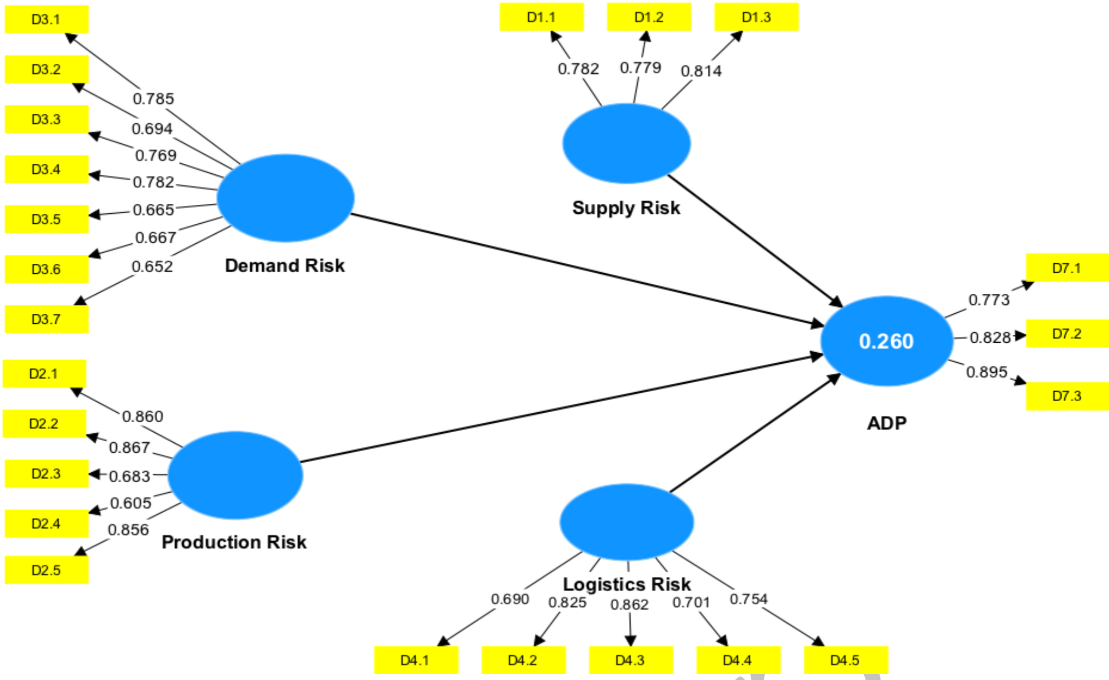

Figure 3. PLS–SEM Results

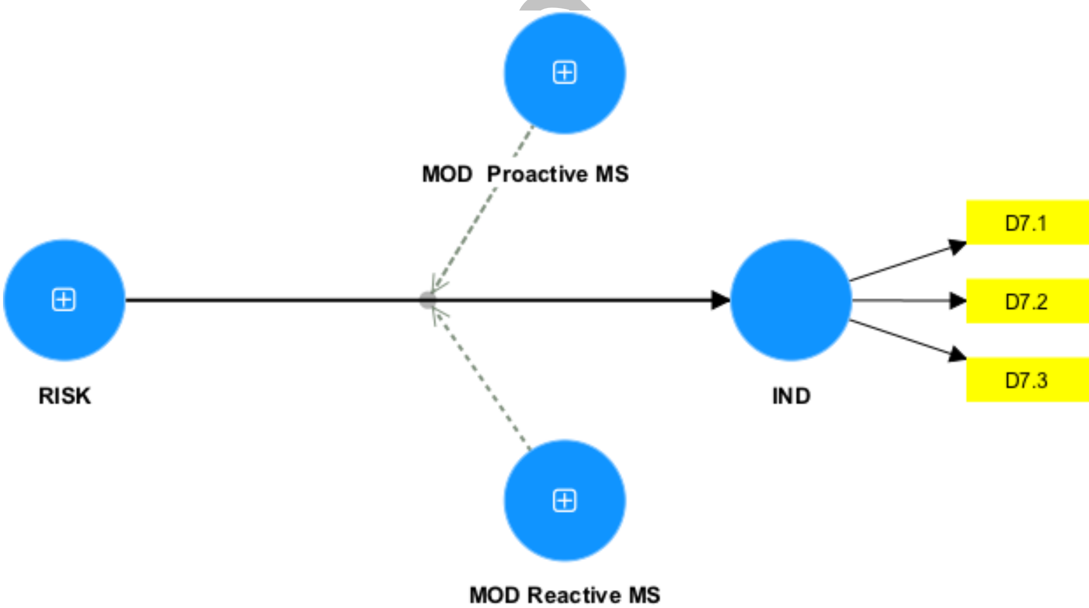

Figure 4. PLS-SEM with moderating effects