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Managing supply chain risks for enhanced logistic performance: insights from the automotive industry in Morocco

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Abstract: In today's volatile business environment, supply chain disruptions pose significant challenges to firms, impacting their logistic performance and overall competitiveness. This study aims to investigate the relationship between supply chain risks and firm logistic performance, with a focus on identifying key risk factors and mitigation strategies. Drawing upon an extensive literature review, a comprehensive framework of supply chain risks, including market risks, supplier risks, and inventory risks, is developed. Through empirical analysis using structural equation modelling (SEM) techniques, data collected from 82 automotive firms are examined to assess the impact of these risk factors on logistic performance indicators. The findings reveal significant associations between various risk factors and logistic performance outcomes, highlighting the critical role of proactive risk management in mitigating disruptions and improving operational efficiency. Practical implications for supply chain managers are discussed, emphasising the importance of implementing robust risk mitigation strategies and fostering resilience in supply chain operations. This research contributes to a deeper understanding of the complex dynamics between supply chain risks and firm performance and provides valuable insights for firms seeking to enhance their competitiveness in today's uncertain business landscape.

Keywords: supply chain management; SCM; logistic performance; supply chain risks; PLS-SEM; Morocco; structural equation modelling; SEM.

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Biographical notes: Mariame Ababou holds a PhD in Economics, Finance, and Management of Organisations. She has a strong academic background and practical expertise in the fields of supply chain management and data science. She is affiliated with the Private University of Fez and serves as a Professor at several universities. In addition to her academic duties, she actively participates in various research projects and has published numerous articles in these domains. Her research interests are centred around supply chain modelling, market analysis, and the application of machine learning in management. She is dedicated to advancing the understanding and application of these disciplines to foster innovation and efficiency in both academic and professional settings.

1 Introduction

In the dynamic landscape of modern business operations, supply chain management (SCM) plays a pivotal role in the success and sustainability of organisations across various industries (Hong et al., 2018). However, the intricacies of managing supply chains come with inherent risks that can significantly impact operational efficiency, customer satisfaction, and ultimately, the bottom line (Pham et al., 2023a). Operational risk, including supply, manufacturing, and demand risks, negatively impact supply chain performance, but integration with suppliers, internal processes, and customers can help mitigate these risks (Gollapudi, 2022). Understanding and mitigating these risks while optimising supply chain performance have become critical imperatives for businesses seeking to maintain a competitive edge in the market.

Supply chain disruptions can stem from various sources, including natural disasters, geopolitical tensions, economic instability, and unexpected changes in consumer demand. These disruptions have become increasingly prevalent and severe in recent years, driven by factors such as globalisation, technological advancements, and heightened competition (Gollapudi, 2022). Consequently, organisations must proactively identify, assess, and mitigate supply chain risks to safeguard their operations and maintain resilience in the face of uncertainty.

Within this context, understanding the intricate relationship between supply chain risks and logistic performance has become paramount for organisations striving to optimise their supply chain operations and enhance competitiveness. Logistic performance, encompassing aspects such as on-time delivery, delivery accuracy, lead-time variability, and fill rate, serves as a critical indicator of supply chain efficiency and effectiveness (Hong et al., 2018). A robust logistic performance not only ensures timely and accurate delivery of goods and services to customers but also enhances operational efficiency, reduces costs, and fosters customer satisfaction (Helmod et al., 2017).

Despite the recognised importance of logistic performance, achieving and maintaining high levels of performance in today's volatile business environment is fraught with challenges. There is significant risks to supply chain operations and can have far-reaching implications for organisational performance (Jain and Benyoucef, 2008). Accurate demand forecasting, effective supplier collaboration, and optimised inventory management are essential strategies for mitigating these risks and enhancing logistic performance (Tadayonrad and Ndiaye, 2023).

Organisations face numerous challenges in maintaining supply chain efficiency and meeting market demands (Jain and Benyoucef, 2008). Among these challenges, risks associated with market demand, supplier reliability, and inventory management are crucial factors that impact the performance of supply chains. Accurate demand forecasting helps in reducing stockouts and excess production, leading to improved customer service and optimised inventory levels (Tadayonrad and Ndiaye, 2023). Collaborative management and effective inventory strategies are essential for achieving supply chain performance goals, such as profitability, customer satisfaction, and internal process effectiveness (Bimha, 2023).

Against this backdrop, this study seeks to investigate the relationship between supply chain risks and logistic performance, with a focus on identifying key risk factors. Drawing upon an extensive literature review, a comprehensive framework of supply

chain risks, including market risks, supplier risks, and inventory risks, will be developed. Through empirical analysis using structural equation modelling (SEM) techniques, data collected from a diverse sample of firms will be examined to assess the impact of these risk factors on supply chain performance indicators.

The findings of this study are expected to provide valuable insights into the complex dynamics between supply chain risks and supply chain performance and offer practical implications for supply chain managers. By understanding the critical role of proactive risk management in mitigating disruptions and improving operational efficiency, organisations can enhance their resilience and competitiveness in today's uncertain business landscape.

2 Literature review and hypothesis development

The theoretical foundation of this study draws upon several established theories and concepts within the field of SCM and risk management. The impact of risk on supply chain performance is a complex issue influenced by various factors such as antecedents, mediators, and moderators. Operational risks, including supply, manufacturing, and demand risks, have a negative impact on supply chain performance, but this impact can be mitigated through integration, specifically internal and customer integrations. Monitoring and mitigating supplier risk, building relationships based on trust and reliability, and involving suppliers in supply chain activities are important factors in improving supply chain performance.

Supply chain risk management (SCRM) has garnered increasing attention as organisations recognise the need to proactively identify, assess, and mitigate risks within their supply chains. Pham et al. (2023b) emphasise the intricate nature of the relationship between risk and performance, highlighting the importance of considering antecedents, mediators, and moderators in understanding this relationship. Their study underscores the significance of comprehensive risk management approaches in navigating supply chain dynamics and optimising performance outcomes.

Logistic performance metrics serve as key indicators of supply chain efficiency and effectiveness. Metrics such as on-time delivery, delivery accuracy, fill rate, and lead time variability are essential for evaluating operational performance and meeting customer expectations. Research by Senna et al. (2023) and others underscores the critical role of these metrics in assessing supply chain performance and identifying areas for improvement. The relationship between supply chain risk and performance is influenced by various mediating and moderating factors. Factors such as integration, sectoral differences (public or private), supplier involvement, and supply chain orientation play crucial roles in shaping this relationship. For instance, Tukamuhabwa (2023) highlights the mediating effect of SCRM capabilities in the relationship between supply chain orientation and performance. Similarly, Senna et al. (2023) demonstrates the moderating effect of sectoral differences on the relationship between supply chain factors and healthcare supply chain performance.

Supply chain performance is closely linked to customer satisfaction, as indicated by several studies. Liangrokapt (2001) and Reiner et al. (2004) both emphasise the importance of customer satisfaction data in measuring and enhancing supply chain performance. Maaz and Ahmad (2022) further support this, demonstrating that supply chain performance positively impacts organisational performance, with customer

satisfaction mediating this relationship. Ou et al. (2010) highlights the role of supply chain dimensions, such as communication and dependence, in influencing customer satisfaction. These findings underscore the critical role of customer satisfaction in evaluating and improving supply chain performance.

Supply chain performance, particularly in terms of reliability of delivery, is a critical factor in achieving competitive excellence (Artsiomchyk and Zhivitskaya, 2016). This is especially true in the context of international supply chains, where the complexity of the network must be effectively managed (Milgate, 2001). Yeh et al. (2014) proposes a reliability indicator for stochastic supply chain networks, considering factors such as transportation damage and limited production capacity. The role of suppliers in ensuring reliable delivery is also emphasised, with the need for efficient supply chains that can respond quickly to market demand (Xia et al., 2008).

Empirical studies employ diverse methodological approaches to investigate the relationship between supply chain risk and performance. SEM, regression analysis, and path analysis are commonly used techniques to analyse empirical data and test theoretical frameworks. Findings from empirical analyses provide valuable insights into the dynamics of supply chain risk and performance, informing the development of effective risk management strategies.

2.1 Market demand risks and supply chain performance

The literature underscores the critical importance of comprehending and effectively managing market demand risks, which encompass shortages of products, fluctuating or unexpectedly increased prices, and unforeseen withdrawal of product lines (Chen et al., 2013; Lei et al., 2012; Duong and Trinh, 2022). Shortages in the market pose the risk of inadequate supply to meet demand, potentially resulting in stockouts and lost sales opportunities, thereby adversely affecting customer satisfaction, loyalty, reputation, and financial performance. Similarly, price fluctuations or unexpected increases can disrupt profitability and pricing strategies, necessitating vigilant monitoring of market conditions and development of mitigative strategies. Furthermore, the sudden withdrawal of product lines can disrupt availability, leading to customer dissatisfaction, underscoring the need for robust contingency plans including diversification of product portfolios and maintaining strong supplier relationships (Chen et al., 2013; Lei et al., 2012; Duong and Trinh, 2022). Proactive SCM practices such as demand forecasting, inventory optimisation, and collaboration with suppliers and customers are advocated to mitigate these risks and enhance supply chain performance, customer satisfaction, and financial outcomes. Research findings consistently demonstrate the significant impact of market demand risks on supply chain performance, with disruptions leading to suboptimal inventory levels, reduced profits, and operational performance.

Hypothesis 1 posits that market demand risks negatively impact logistic performance.

2.2 Supplier risks and supply chain performance

The scholarly examination of supplier risks and their implications for logistic performance elucidates the deleterious ramifications of various factors, including the unforeseen termination of key supplier relationships, inadequate logistic performance from suppliers, misinterpretation of logistical requirements, and issues pertaining to

product quality (Duong and Tran, 2022; Hallikas and Lintukangas, 2016; Ritchie and Brindley, 2009; Wang-Mlynek and Foerstl, 2020). The sudden cessation of a critical supplier introduces significant risks, precipitating supply chain disruptions, shipment delays, and diminished delivery accuracy, thereby necessitating robust contingency measures such as the identification of alternative suppliers and the cultivation of resilient supplier networks (Hallikas and Lintukangas, 2016). Moreover, deficiencies in logistic performance, characterised by delivery delays and inadequate transportation capacities, directly impede logistic efficacy, highlighting the imperative of vigilant monitoring, the establishment of transparent performance metrics, and collaborative efforts to ameliorate supplier performance (Duong and Tran, 2022; Ritchie and Brindley, 2009). Misinterpretation of logistical requirements by suppliers can engender shipment inaccuracies and compromised delivery precision, underscoring the indispensability of effective communication channels and precise specifications (Ritchie and Brindley, 2009; Wang-Mlynek and Foerstl, 2020). Furthermore, quality lapses in supplied goods may engender delays and errors, accentuating the importance of rigorous quality control protocols and expedient resolution mechanisms (Duong and Tran, 2022; Hallikas and Lintukangas, 2016). Proactive supplier management strategies, encompassing comprehensive evaluation, continuous monitoring, and collaborative engagements, emerge as essential tools for mitigating these risks and fortifying overall supply chain efficiency.

Hypothesis 2 posits that supplier risks exert a negative influence on logistic performance.

2.3 Inventory risks and supply chain performance

The literature review on inventory risks and logistic performance underscores the adverse effects of inventory obsolescence and deterioration on logistic performance (Duong and Tran, 2022; Zhu et al., 2017; Silbermayr and Minner, 2014; Ganeshan et al., 2001). Obsolescence of stocks presents a significant risk, leading to inventory write-offs and financial losses while tying up valuable resources and causing increased lead time variability, ultimately diminishing delivery accuracy and fill rate (Duong and Tran, 2022). Similarly, the deterioration of stocks, such as perishable goods, can result in inventory write-offs and financial losses, exacerbating lead time variability and impairing delivery accuracy and fill rate (Duong and Tran, 2022). Effective inventory management practices, including demand forecasting and inventory optimisation, are crucial for mitigating these risks and ensuring optimal stock levels. Proactive strategies like just-in-time (JIT) or lean inventory practices are advocated to reduce the risk of inventory obsolescence and deterioration, thereby enhancing logistic performance. Studies by Zhu et al. (2017), Silbermayr and Minner (2014), and Ganeshan et al. (2001) further elucidate the importance of information sharing, technology adoption, and inventory planning parameters in mitigating inventory risks and improving supply chain performance.

Hypothesis 3 posits that inventory risks exert a negative influence on logistic performance.

3 Data and method

3.1 Study design and data collection

The data for this study were collected from the automotive industry, specifically targeting firms involved in the production, distribution, and supply of vehicles and automotive components. A structured survey questionnaire was developed to gather insights into supply chain risk factors and logistic performance indicators tailored to the automotive sector.

Survey participants were chosen from a diverse range of companies within the automotive industry, including original equipment manufacturers (OEMs), component suppliers, aftermarket parts manufacturers, distributors, and logistics service providers. Key decision-makers and professionals responsible for SCM and logistics operations were targeted as respondents.

The survey questionnaire was distributed electronically to the identified participants, leveraging email lists, industry associations, and professional networks to reach potential respondents. Participation was voluntary, and respondents were assured of the confidentiality and anonymity of their responses. The questionnaire aimed to capture information on various aspects of supply chain risks, including market demand risks, supplier risks, and inventory risks, alongside logistic performance indicators such as customer satisfaction and reliability of delivery. Questions were designed to gather both qualitative and quantitative data, facilitating a comprehensive understanding of supply chain dynamics in the automotive industry (Table 1).

Table 1 Constructs and items in survey questionnaire for the automotive industry

<i>Construct</i>	<i>Items</i>
Market demand risks (RM)	Shortage of products in the market (R4) Fluctuation or unexpected price increases (R5) Unexpected withdrawal of a product line (R7)
Supplier risks (RSM)	Unforeseen cessation of a key supplier (R1) Deficient logistic performance of suppliers (R2) Problem of quality (R3)
Inventory risks (RS)	Obsolescence of stocks (R8) Deterioration of stocks (R9)
Supply chain performance (PL)	Customer satisfaction (SC) Reliability of Delivery (FL)

Prior to the main survey, a pilot study was conducted with a small group of automotive industry professionals to test the clarity, relevance, and effectiveness of the questionnaire. Feedback from the pilot study was incorporated to refine the survey instrument and ensure its suitability for the target audience.

3.2 Data and method

Upon completion of the survey, the collected data underwent thorough preparation for analysis, including cleaning to address missing values, outliers, or inconsistencies,

ensuring the integrity and reliability of the dataset. SEM techniques were utilised for inferential analysis of the 82 firms under the study. We utilised partial least squares (PLS) path modelling, specifically employing PLS 3 Software, allowing examination of relationships between supply chain risks and logistic performance outcomes. Structural model was estimated to test hypothesised relationships.

Bootstrap resampling techniques were applied to test the significance of path coefficients and assess result stability, with sensitivity analyses conducted to evaluate robustness and explore variations across different segments of the automotive supply chain.

This comprehensive approach allowed for a rigorous examination of both the measurement and structural models, uncovering insights into the complex dynamics of SCM and logistics performance in the automotive industry.

4 Results

4.1 Measurement model assessment

4.1.1 Internal consistency reliability and convergent validity

We shall evaluate the internal consistency of our data through the utilisation of composite reliability, a method more robust than Cronbach’s alpha for assessing measurement reliability (Hair et al., 2019). The ensuing table illustrates the composite reliability values for each latent variable within our model. Notably, all values surpass the acceptable threshold of 0.7 (refer to Table 2), as advocated by Tenenhaus et al. (2005). Hence, we can confidently assert the reliability of our measurement model concerning internal consistency.

Concerning convergent validity, the contributions of the seven indicators to their respective factors exceed the threshold of 0.7, indicating satisfactory performance. Additionally, three indicators register contributions falling between 0.4 and 0.7, a range deemed acceptable, particularly for nascent scales (Hair et al., 2019; Hulland, 1999). Consequently, convergent validity is duly established per the first criterion. Furthermore, the average variance extracted (AVE) for all constructs surpasses 0.5, thereby affirming convergent validity in accordance with the second AVE criterion.

Table 2 Composite reliability and AVE for variables

<i>Variables</i>	<i>Composite reliability</i>	<i>Average variance extracted (AVE)</i>
PL	0.997	0.993
RM	0.852	0.666
RS	0.718	0.563
RSM	0.859	0.675

4.1.2 Discriminant validity

We shall proceed to examine whether the phenomenon encapsulated by each construct remains distinct from representations offered by other constructs within the model. This evaluation entails scrutinising the cross-loadings of indicators corresponding to each factor. Table 3 presents these pertinent cross-loadings.

Table 3 Cross-loadings for discriminant validity analysis

	<i>PL</i>	<i>RM</i>	<i>RS</i>	<i>RSM</i>
FL	0.997	−0.880	−0.439	−0.863
R1	−0.881	0.945	0.207	0.749
R2	−0.435	0.577	0.046	0.313
R3	−0.786	0.879	0.482	0.686
R4	−0.479	0.427	0.127	0.639
R5	−0.829	0.741	0.320	0.887
R7	−0.772	0.640	0.412	0.912
R8	−0.278	0.244	0.671	0.354
R9	−0.362	0.250	0.822	0.221
SC	0.997	−0.897	−0.418	−0.864

Our observation reveals that each indicator exhibits a stronger correlation with its corresponding construct than with other constructs within the model. This suggests that all indicators align more closely with their respective constructs. Consequently, discriminant validity is established based on this criterion. Let us proceed to the final criterion of discriminant validity, which is the Fornell-Larcker criterion (Table 4).

Table 4 The Fornell-Larcker criterion

	<i>PL</i>	<i>RM</i>	<i>RS</i>	<i>RSM</i>
PL	0.997			
RM	−0.892	0.816		
RS	−0.430	0.327	0.750	
RSM	−0.867	0.752	0.369	0.887

Upon comparing the average variance of each construct, as shown along the diagonal of the table, with the correlations displayed in the remaining cells, it becomes evident that the average variance of each construct exceeds its correlations with other constructs. This observation indicates that our constructs are distinct and separate entities. Consequently, it suggests the discriminant validity of the measurement model.

4.2 Evaluation of structural model validity

4.2.1 Evaluation of explained variance (R^2) and effect size (f^2)

In the evaluation of the structural model's validity, we first assessed the explained variance of endogenous latent variables (R^2). Through computing the coefficient of determination, we found that 89.2% of the variance in performance can be elucidated by the three explanatory variables – RS, RM, and RSM. This substantial percentage aligns with the criteria set forth by Cohen (1988) and Chin (1998), indicating the significance of the model's explanatory power.

Subsequently, we examined the effect size (f^2) to gauge the relative impact of each exogenous latent variable on the endogenous latent variables. Results revealed that the variables RSM and RM exhibit large effects on the endogenous variable PL, with f^2

values of 0.692 and 1.161, respectively, while RS demonstrates a smaller effect ($f^2 = 0.074$). These findings underscore the influence of the exogenous variables on the endogenous variables, albeit with variations in magnitude, thus elucidating the nuanced dynamics within the structural model. These results contribute to a deeper understanding of the relationships between the variables and provide valuable insights for further research and practical applications in the domain of SCM.

4.2.2 Evaluation of predictive relevance and significance testing of regression coefficients

In assessing predictive relevance, we utilised the Q^2 value of Stone-Geisser to gauge the predictive quality of latent variables in the path model. Our analysis revealed a Q^2 value of 0.150 for the endogenous variable PL. This result indicates that both the commercial performance and economic-financial performance models exhibit predictive quality, as $Q^2 > 0$, aligning with the guidelines of Tenenhaus et al. (2005) and Hair et al. (2019).

To test the significance of regression coefficients, we employed the Bootstrap method, a resampling technique with replacement. While the minimum recommended number of resampling iterations is 100, we opted for 5,000 iterations to ensure result stability, as suggested by Tenenhaus et al. (2005). The results from the bootstrap method indicate the significance of the regression coefficients in the path model. The T statistics values, along with their associated p-values, provide insights into the strength and significance of the relationships between the exogenous and endogenous variables. Specifically, the coefficient for RM to PL is highly significant, with a T statistic of 9.867 and a p-value of 0.000, indicating a strong relationship between these variables at the 1% significance level. Similarly, the coefficients for RS to PL and RSM to PL are also significant, with T statistics of 2.067 and 6.723, respectively. However, while the coefficient for RS to PL is significant at the 5% level, the coefficient for RSM to PL is significant at the 1% level (Table 5).

Table 5 Significance of regression coefficients after bootstrapping

Links	T Statistics	P Values	Results
RM → PL	9,867	0.000	Significant at 1%
RS → PL	2,067	0.039	Significant at 5%
RSM → PL	6,723	0.000	Significant at 1%

4.2.3 Overall model evaluation

To assess the overall model, we computed the goodness-of-fit (GOF) index, which considers both the performance of the structural model and the measurement model:

$$GOF = \sqrt{AVE \times R^2}$$

We obtained a GOF index for our model of $GOF = 0.8037605365$. Following the guidelines of Wetzels et al. (2009), a GOF index exceeding 0.80 is deemed strong. Thus, the GOF of our model is considered strong, confirming the validity of our global SEM-PLS model.

The results from evaluating our structural model indicate its predictive validity, making it suitable as a tool for predicting the relationships between risk components and

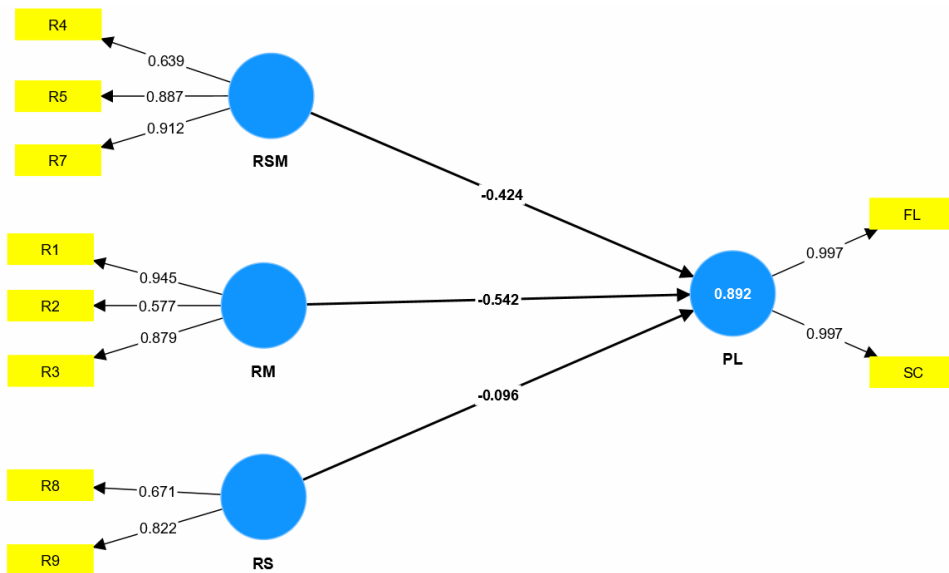
logistic performance in businesses. Furthermore, the high GOF of the global model enhances its internal and external validity, highlighting its utility and reliability in understanding and predicting relationships within the context of business logistics.

4.3 Path coefficients and hypothesis test

The results of the structural model indicate that RM has the strongest effect on logistic performance (-0.542), followed by RSM (-0.424) and RS (-0.096). Furthermore, the three constructs explain 89.2% of the variance in the endogenous construct logistic performance ($R^2 = 0.892$). This rate is considered strong and substantial according to Cohen (1988). The sizes of the path coefficients are presented in the following diagram (Figure 1).

By examining the sizes of the path coefficients, we determine if they are statistically significant. Based on their magnitude, it appears that the relationships: $RSM \rightarrow PL$; $RM \rightarrow PL$ are significant. However, it seems that the relationship of the hypothetical path $RS \rightarrow PL$ (0.096) is not significant. Generally, for sample sizes of up to about 1,000 observations, path coefficients should exhibit values above 0.20 to be considered significant, while those with values below 0.10 are not considered significant (Hair et al., 2019).

Figure 1 Structural equation model results (see online version for colours)



Thus, it can be concluded that both exogenous variables RSM and RM have a negative and statistically significant influence on logistic performance with different effect sizes. Therefore, Hypotheses 1 and 2 are valid. However, RS appears to have no significant effect on logistic performance. It is important to note that the identified links are direct links that do not pass through intermediary variables. The only non-significant direct link is between RS and PL. However, the hypothesis that a link may exist remains valid if

other measurement indicators are chosen. Nevertheless, the nature of this link remains to be determined.

5 Discussion

The findings of this study contribute to the existing body of knowledge by providing insights into the intricate relationship between supply chain risks and logistic performance in the context of the automotive industry. The comprehensive framework developed in this study incorporates various dimensions of supply chain risks, including market risks, supplier risks, and inventory risks, allowing for a holistic examination of the factors influencing logistic performance. Through empirical analysis using SEM techniques, the study empirically validates the impact of these risk factors on logistic performance indicators, thereby enhancing our understanding of supply chain dynamics and performance optimisation strategies.

One of the key findings of this study is the significant association between supply chain risk factors and logistic performance outcomes. The results reveal that market demand risks, supplier risks, and inventory risks all exert a negative influence on logistic performance, highlighting the critical importance of proactive risk management in mitigating disruptions and enhancing operational efficiency (Gollapudi, 2022; Pham et al., 2023b; Tadayonrad and Ndiaye, 2023).

The observed effect sizes of the exogenous variables on logistic performance provide valuable insights into the relative importance of different risk factors. Specifically, the findings suggest that supplier-related risks, represented by variables such as unforeseen supplier cessation and deficient supplier performance, have a particularly strong impact on logistic performance (Duong and Tran, 2022; Hallikas and Lintukangas, 2016).

Furthermore, the results indicate that while market demand risks and inventory risks also influence logistic performance, their effect sizes are comparatively smaller. This suggests that while these risk factors may contribute to supply chain disruptions, their impact on logistic performance may be mitigated through effective demand forecasting, inventory optimisation, and collaboration with suppliers and customers (Zhu et al., 2017; Silbermayr and Minner, 2014).

The findings of this study have practical implications for supply chain managers and practitioners in the automotive industry. By understanding the critical role of proactive risk management in mitigating disruptions and improving operational efficiency, organisations can develop and implement robust risk mitigation strategies tailored to their specific supply chain contexts. This may include measures such as diversifying supplier networks, implementing demand forecasting algorithms, optimising inventory levels, and enhancing collaboration with key stakeholders (Lei et al., 2012).

Moreover, the findings underscore the importance of resilience-building initiatives aimed at enhancing the adaptability and agility of supply chain operations in response to changing market conditions and unforeseen disruptions. By fostering a culture of resilience and continuous improvement, organisations can enhance their competitiveness and ensure long-term sustainability in today's uncertain business landscape (Artsiomchyk and Zhivitskaya, 2016; Yeh et al., 2014).

However, it is essential to acknowledge the limitations of this study and avenues for future research. While the empirical analysis provides valuable insights into the relationship between supply chain risks and logistic performance, the study is limited to

the automotive industry and may not be generalisable to other sectors. Future research could explore the applicability of the proposed framework in other industries and examine additional factors that may influence logistic performance, such as environmental sustainability practices and digitalisation initiatives (Jain and Benyoucef, 2008; Maaz and Ahmad, 2022).

Overall, this study contributes to a deeper understanding of supply chain dynamics and performance optimisation strategies in the face of evolving market conditions and increasing uncertainties. By identifying key risk factors and their impact on logistic performance, the study provides valuable insights for organisations seeking to enhance their competitiveness and resilience in today's dynamic business environment.

6 Conclusions

The study contributes significant insights into the intricate relationship between supply chain risks and logistic performance within the automotive industry. The findings underscore the detrimental effects of market demand, supplier, and inventory risks on logistic efficiency and overall supply chain effectiveness. By identifying these key risk factors, organisations are better equipped to develop and implement proactive risk management strategies aimed at mitigating disruptions and enhancing operational resilience.

Looking ahead, future research could delve deeper into the effectiveness of specific risk mitigation tactics tailored to different segments of the automotive supply chain. Exploring the role of emerging technologies, such as internet of things (IoT) sensors and predictive analytics, in anticipating and mitigating supply chain risks presents a promising avenue for further investigation. Moreover, examining the impact of regulatory changes and geopolitical factors on supply chain dynamics could provide valuable insights into navigating uncertainties in the global business landscape.

Furthermore, considering the increasing complexity and interconnectedness of supply chains, there is a need to explore collaborative risk management approaches among supply chain partners. By fostering greater transparency, communication, and collaboration, organisations can build more resilient and agile supply chains capable of adapting to evolving market conditions and disruptions.

Leveraging the findings of this study, along with continued research and innovation in SCRM, organisations can proactively address challenges, optimise logistic performance, and ultimately strengthen their competitiveness in the automotive industry and beyond.

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