The Relationship between Sustainability and Resilience in Supply Chains: An Empirical Study on the Egyptian Manufacturing Firms

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Abstract

In the face of increasing environmental concerns, market volatility, and global disruptions, the imperative for sustainable and resilient supply chains has never been more pronounced. This study aims to explore the relationship between the implementation of sustainable supply chain management (SSCM) practices and the achieved level of supply chain resilience (SCR) within the context of the Egyptian manufacturing firms.

Employing a quantitative approach that includes analysis of survey data from 396 Egyptian manufacturing firms, this study reveals that SSCM practices are significantly correlated with enhanced SCR, suggesting that sustainability-oriented strategies are crucial for building resilient supply chains.

This research contributes to the literature in several ways. First, it adds to the existing knowledge about the SSCM-SCR relationship in general, and within the developing countries context, in specific. Second, it adopts a new operationalization approach for the SSCM practices by merging social and economic practices within a single factor and separating supplier management practices from internal environmental management practices. Third, it provides empirical evidence for supporting the role of implementing SSCM practices in enhancing SCR within the developing countries context.

Thus, this research offers practical insights for managers, aiming to fortify their supply chains against disruptions while concurrently advancing sustainability goals. It suggests that Egyptian manufacturing firms can significantly benefit from integrating environmental, economic, and social sustainability practices into their supply chain operations. This integration provides a competitive edge by increasing the resilience of supply chains, thus ensuring business continuity and reducing vulnerability to external shocks.

***Keywords**: SSCM, SCR, Manufacturing Firms, Egypt.*

Introduction

The concept of sustainability in supply chains has become increasingly recognized in recent years, driven by a combination of environmental concerns, social responsibility, regulatory pressures, and consumer demand for ethical practices (Mohammed et al., 2023). Integrating sustainable practices into supply chain operations is crucial for reflecting its impact on the environment, society, and the economy (Zhu & Wu, 2022).

Sustainable supply chain management (SSCM) practices aim to minimize the environmental footprint of products by reducing waste, conserving natural resources, and decreasing greenhouse gas emissions. Moreover, ethical supply chains contribute to improving the quality of life for workers and communities involved in production processes, which is key to building equity and social justice global-

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ly (Miemczyk & Luzzini, 2019). As consumers are becoming more aware of the different impacts of their purchases, many prefer to buy products from companies that demonstrate commitment to sustainability. Although implementing sustainable practices can require upfront investment, they often lead to cost savings in the long term (Jabbarzadeh et al., 2018).

From another perspective, recent increasingly apparent global challenges, such as natural disasters, geopolitical tensions, and trade disputes, emphasize the supply chains need to become resilient. Resilient supply chains could adapt to disruptions, maintain operations during unforeseen events, and recover more quickly afterward (Ali et al., 2022; Chunsheng et al., 2020; Jabbarzadeh et al., 2018). In addition, resilient supply chains minimize their losses by quickly responding to challenges, thereby protecting the company's financial health (Ambulkar et al., 2015; Hussain et al., 2022).

Additionally, by fostering closer relationships with suppliers and emphasizing ethical sourcing, companies can achieve greater visibility and control over their supply chains (Grieser & Pedell, 2021). In that sense, there are different research streams that studied the relationship between sustainability and resilience in supply chains, however, there is still a need to investigate the theorization of new frameworks to build resilience through sustainability (Queiroz et al., 2022; Sarkis et al., 2011).

Several research demonstrate that SSCM activities have a sustainable impact on supply chain resilience (SCR) and financial performance, although the focus was mostly directed to developed countries. This means that companies that engage in SSCM practices are better equipped to handle disruptions (Yang & Wang, 2023). Also, other research has shown some conflicting results regarding the impact of SSCM practices on SCR (Eggert & Hartmann, 2022; Hussain et al., 2022).

Based on the abovementioned discussions, the motive behind this study stems from two issues. First, the scarcity of studies that consider the developing economies despite the increasingly interconnected global economy and the vulnerability of these nations to disruptions (Kumar & Anbanandam, 2020). Second, the conflicting results in previous studies regarding the relationship between SSCM practices and SCR.

Thus, this research aims to investigate the effect of implementing SSCM practices on SCR withing the context of the Egyptian manufacturing sector as a developing country. This research employed the complexity theory as the theoretical base to study the impact of implementing SSCM practices on SCR by considering that "implementing sustainability is necessary for the firm to be sensitive and responsive to the external environment with interdependencies in adapting to the system" (Sarkis et al., 2011; Dubey et al., 2017).

Literature Review

Supply Chain Resilience

SCR refers to the ability of a supply chain to prepare for, respond to, adapt, and recover from various types of disruptions or unexpected events, ensuring continuity of operations and minimizing impacts on performance, profitability, and customer satisfaction. This concept encompasses the capacity to absorb shocks, such as natural disasters, political instability, economic fluctuations, or technological failures, and to swiftly return to normal or improved operating conditions (Kähkönen et al., 2023).

A resilient supply chain is characterized by its flexibility, agility, and robustness, enabling it to not only withstand adverse conditions but also to evolve and thrive in the face of challenges. Scholten et al. (2014) considered flexibility, taking collaborative decisions with partners and high situational awareness as measured for SCR while Al Naimi et al. (2021) added coping with change and quick response to the variable measures. Ali et al. (2022) included ability to respond quickly, moving to new desirable state after disruption and learning from change in the variable measurement tool. Haq et al. (2023) and Liu et al. (2023)

focused on ability to cope with change and the adaptation and flexibility to any disruptive event. Also, Hamidu et al. (2023) measured SCR by including collaboration with supply chain partners, recovery to a desirable state and learning from change.

Based on previous studies, the current research adopted a scale to measure the level of resilience of a supply chain that resulted from implementing different organizational activities.

Sustainable Supply Chain Management Practices

Sustainable supply chain practices refer to the integration of environmentally and socially responsible strategies within the procurement, production, and distribution processes of a company's supply chain (Paul et al., 2021). These practices aim to minimize ecological damage, promote fair labor conditions, and ensure the efficient use of resources throughout the lifecycle of a product or service (Michel-Villarreal, 2023).

SSCM practices are classified, according to the triple bottom line approach, into three main pillars: environmental, social, and economic practices. The environmental pillar of SSCM involves ensuring that the supply chain operations are environmentally responsible, this includes using renewable energy, reducing waste, using recycled materials, and implementing ethical manufacturing practices (Yang & Wang, 2023). By addressing climate change, conserving resources, preventing pollution, conserving biodiversity, and promoting sustainable product design, businesses can contribute to a more sustainable and responsible global ecosystem (Mirzaei et al., 2023; Saqib & Zhang, 2021).

The social pillar of SSCM focuses on the social impact of supply chain practices. This includes ethical treatment of workers, fair labor practices, community engagement, human rights, labor standards, and social equity within the supply chain (Mirzaei et al., 2023). Social sustainability is about fostering positive relationships with employees, suppliers, and local communities, and ensuring fair and safe working conditions (Gruchmann & Seuring, 2018).

The economic pillar emphasizes on the need for companies to strike a balance between pursuing their own development and considering the economy, environmental protection, and social stability (Ivanov, 2018). By redesigning and establishing management processes, the stability of enterprises can be enhanced, and increasing vulnerabilities and crises can be effectively dealt with to ensure economic development (Zhu & Wu, 2022). Additionally, the economic pillar of SSCM involves the management of suppliers and customers to implement external SSCM practices and achieve sustainable goals (Eggert & Hartmann, 2022).

Research Framework and Hypothesis

Researchers have made early attempts in recent years to investigate the linkages and intersections between sustainability and resilience in the context of SCM, studying the impact of implementing sustainable practices and initiatives on the responsiveness, flexibility, and awareness of manufacturing organizations during disruptions (Kähkönen et al., 2023).

SSCM practices encourage a long-term perspective, which can lead to investments in technologies and processes that improve overall resilience to disruptions. This forward-looking approach can help organizations better prepare for and respond to unexpected events (Carissimi et al., 2023).

Organizations can capitalize on their adoption of environmental practices to boost their organizational resilience. Environmental practices such as energy efficiency, waste reduction, and circular economy principles can lead to more efficient use of resources within the supply chain. This efficiency can contribute to greater flexibility and adaptability in the face of disruptions (Holgado et al., 2024).

Moreover, implementing economic supply chain practices often supports the collaboration with suppliers, local communities, and other stakeholders to enhance communication and trust (Ivanov, 2022).

Mohammed et al. (2023) found that the economic supply chain practices have a positive impact on SCR, as the provision of more facilities have a potential to improve the responsiveness and flexibility of supply chains. But the high cost of providing such resources may hinder the organizations' ability of adopting such practices.

Social SSCM activities directed at the supply chain evolve around ensuring the health, safety, and well-being of suppliers (Marshall et al., 2015). Numerous advantages linked to resilience stem from social initiatives, which serve to mitigate the extent of loss and expedite recovery times (Miemczyk & Luzzini, 2019).

However, previous studies provided some conflicting results regarding this relationship. For example, Eggert & Hartmann (2022) found that the result of SSCM practices on the recovery time is insignificant. When studying the predictor variable into its environmental and social subcomponents, they found that environmental SSCM practices significantly affects SCR readiness, but social SSCM practices does not. Accordingly, practices covering the three SSCM pillars were questioned to have an impact on the SCR.

Moreover, many of these studies were focus on developed economies (Ciasullo et al., 2022; Liu et al., 2023; Yang & Wang, 2023; Yuan & Li, 2022) with limited focus on developing countries (Haq & Aslam, 2023; Jabbarzadeh et al., 2018; Kumar & Anbanandam, 2020).

Accordingly, this research, based on the complexity theory, propose that the implementation of SSCM practices (including environmental, economic, and social practices) enhances the level of resilience of the supply chain. The complexity theory suggests that firms operate in a complex system that includes diversity of environmental factors such as customers, suppliers, government regulations, and technological advancements (Chakravarthy, 1997). Thus, the main research hypothesis (as shown in figure 1) is as follows:

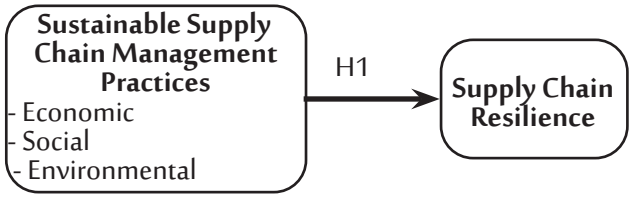

Figure 1: Research framework

- H1: It's expected that higher level of implementing SSCM (SSCM) practices lead to an increased SCR (SCR) for unexpected supply chain disruptions.

Since SSCM practices are theoretically classified into three pillars; environmental, social, and economic, the research main hypothesis could be divided into the following three hypotheses:

- H1a: It's expected that higher level of implementing social SSCM practices lead to an increased SCR for unexpected supply chain disruptions.
- H1b: It's expected that higher level of implementing environmental SSCM practices lead to an increased SCR for unexpected supply chain disruptions.
- H1c: It's expected that higher level of implementing economic SSCM practices lead to an increased SCR for unexpected supply chain disruptions.

Research Methodology

This research adopts a comprehensive and systematic approach to methodology, aiming to ensure the accuracy, reliability, and validity of its findings within the field of study. At the heart of our methodological framework is a carefully designed research questionnaire, evaluated and refined through expert feedback from both practitioners and academics.

Exploratory research serves as the foundation for understanding complex phenomena, offering a preliminary investigation that aims to uncover the underlying nature, dynamics, and scope of a particular issue or question (Acioli et al., 2021).

This research started with reviewing recent studies covering both SSCM practices and SCR as well as the relationship between them. Following this, a questionnaire was developed to collect data needed for testing the research hypothesis withing the context of Egyptian manufacturing firms.

Questionnaire Development

SSCM practices (Independent Variable) were measured using 27 items drawn from previous studies (Baliga et al., 2020; Eggert & Hartmann, 2022; Kot, 2018; Miemczyk & Luzzini, 2019; Mirzaei et al., 2023; Saqib & Zhang, 2021; Yang & Wang, 2023). Respondents were asked to evaluate the level of implementation for each item using 5-point Likert scale ranging from 1 that indicates not implemented to 5 that indicates full implementation.

SCR (Dependent Variable) was measured using 7 items drawn from previous studies (Al Naimi et al., 2021; Ali et al., 2022; Hamidu et al., 2023; Haq & Aslam, 2023; Hussain et al., 2022; Liu et al., 2023). Respondents were asked to evaluate the level of achievement for each item using 5-point Likert scale ranging from 1 that indicates strongly disagree to 5 that indicates strongly agree.

The research questionnaire underwent a rigorous validation process, being carefully evaluated by a panel comprising both seasoned practitioners from the industry and distinguished academics in the field of supply chain management. Their scrutiny led to the paraphrasing of some items to eliminate ambiguity and enhance understanding. Moreover, their expert feedback highlighted gaps in the exploration of sustainable supply chain practices, prompting the addition of two crucial questions designed to capture a broader and more nuanced understanding of sustainability initiatives within supply chains.

Population and Sample

The research population for this study encompasses an expansive and diverse group of approximately 40,000 manufacturing companies listed in the Industrial Modernization Center (IMC) in Egypt. This comprehensive database reflects a wide spectrum of sectors within the Egyptian manufacturing industry. The IMC's repository serves as a crucial resource, enabling researchers to tap into a rich vein of potential respondents who can offer valuable perspectives on SCR and sustainability practices.

The target respondents for this study were carefully selected to include individuals from either top or middle management levels who are responsible for managing the supply chain within the manufacturing companies. This choice ensures a multifaceted perspective on the practices and challenges related to SSCM practices, as these management layers play crucial roles in decision-making, strategy implementation, and operational oversight.

In this research, the deployment of a random sampling technique is a strategic methodological choice aimed at enhancing the validity and reliability of the study's findings (Budhiartini Yuli Isnaini et al., 2020). Considering the vast and diverse population of manufacturing companies registered with the Industrial Modernization Center (IMC) in Egypt, a random sampling approach ensures that every entity within this population has an equal probability of being selected for the study (Wan Ahmad et al., 2016).

Data Collection

Data collection process was designed to encompass a multi-faceted approach, utilizing mail, phone calls, and face-to-face visits to distribute questionnaires to the target respondents. This diverse methodology ensured a wider reach and accessibility of different respondents. Following the initial distribution of the questionnaires, the research team implemented a strategic follow-up process two weeks later, deploying reminders through the same channels. This follow-up was critical in enhancing the response rate (Um & Han, 2021).

The research questionnaire was administered to 850 respondents; 408 questionnaires representing 48%, were returned, 12 questionnaires representing 1.4%, were incomplete or ineligible or refusals, and 442 (52%) were not reached. There were 396 acceptable responses, a response rate of 46.5%, which is adequate for the nature of this study. Table (I) shows the demographic distribution of research respondents.

Data Analysis Methods

A rigorous two-phase data analysis process was adopted to ensure the comprehensive examination and validation of the collected data. The first phase focused on assessing the measurement scale's validity and reliability through both exploratory and confirmatory factor analysis. This foundational step was crucial for identifying underlying constructs and confirming that the measurement scales accurately represented the theoretical constructs they were intended to measure, thereby establishing the groundwork for robust statistical analysis. Following this, the second phase entailed conducting multiple linear regression analysis for the main hypothesis between SSCM and SCR. This phase aimed to explore the relationships between variables, determine the strength and direction of these relationships.

Table I: The Demographic Distribution of Research Respondents.

		Frequency	Percent
Location	Cairo	138	34.8
	Alexandria	130	32.8
	10th of Ramadan	70	17.7
	Ain Sokhna	40	10.1
	Other	18	4.5
	Total	396	100.0
Industry Type	Metal Machinery and Engineering	92	23.2
	Pharmaceutical	92	23.2
	Steel Manufacturing	54	13.6
	Food and Beverages	50	12.6
	Chemicals and Petrochemicals	38	9.6
	Other	25	6.3
	Wood and Furniture	25	6.3
	Textiles	20	5.1
	Total	396	100.0
Company Size (# of employees)	More than 1000	191	48.2
	Less than 100	73	18.4
	From 100 to 300	61	15.4
	From 301 to 500	53	13.4
	From 501 to 1000	18	4.5
	Total	396	100.0
Respondent Experience (Years)	More than 15	206	52.0
	From 11 to 15	100	25.3
	From 5 to 10	68	17.2
	Less than 5	22	5.6
	Total	396	100.0
Respondent Education	BSc	146	36.9
	MSc	166	41.9
	PhD	84	21.2
	Total	396	100.0

Results

Measurement Scale Validity and Reliability

For the independent variable (SSCM), exploratory factor analysis resulted in removing 7 items due to low factor loading (less than 0.4), categorizing the remaining 22 items into three factors, factor 1: socio-economic practices represented by 12 items, factor 2: environmental practices represented by 7 items and factor 3: supplier management practices represented by 3 items.

Following this, confirmatory factor analysis resulted in removing another 3 items from factor 1 for enhancing the measurement model fit and validity. Table II shows factor loadings, Cronbach's α values, composite reliability (CR), and average variance extracted (AVE) of each dimension as well as the model fit indices. The SSCM measurement model showed acceptable model fit ($\chi 2/df = 3.591$; $p < 0.001$; RMSEA = 0.08; CFI = 0.959; TLI = 0.951) (Hair et al., 2010.; Mackenzie et al., 2011) which supports the fit and the unidimensionality of the model.

Reliability analysis is accomplished by calculating both Cronbach's α and composite reliability (CR) coefficients for each dimension. As shown in table II, all Cronbach's α coefficients for the three factors are above 0.70 which supported the reliability of all factors and deemed sufficient for confirmatory research (Hair et al., 2010). Moreover, the composite reliability (CR) for the three factors were exceeding the recommended threshold of 0.70 (Hair et al., 2010), assuring internal consistency which means that the items measured its construct reliably. In addition, as shown in table I, all standardized factor loadings were above 0.50 cut-off point and were statistically significant ($p < 0.05$). The AVEs were above 0.50 and higher than the SIC for all factors. Thus, convergent and discriminant validity were confirmed.

Based on this modified classification of SSCM practices, the research hypotheses are modified as follows:

- H1a: It's expected that higher level of implementing socio-economic SSCM practices lead to an increased SCR for unexpected supply chain disruptions.

- H1b: It's expected that higher level of implementing environmental SSCM practices lead to an increased SCR for unexpected supply chain disruptions.
- H1c: It's expected that higher level of implementing supplier management SSCM practices lead to an increased SCR for unexpected supply chain disruptions.

For the dependent variable (SCR), exploratory factor analysis resulted in categorizing all the 7 items into one factor as shown in table III. The confirmatory factor analysis for the SCR measurement model showed acceptable model fit ($\chi 2/df = 2.861$; $p < 0.05$; RMSEA = 0.069; CFI = 0.993; TLI = 0.983) (Hair et al., 2010; MacKenzie et al., 2011) which supports the fit and the unidimensionality of the model. Moreover, Cronbach's α coefficient and CR exceed the recommended threshold of 0.70 which demonstrates the construct reliability. Convergent and discriminant validity were also confirmed as shown in table III. All standardized factor loadings were above 0.50 cut-off point and were statistically significant ($p < 0.05$) and the AVE was above 0.50 and higher than the SIC.

Table II: SSCM Measurement Model Assessment

Factors	Items	Standardized Factor Loadings	Cronbach's α	CR	AVE
Factor 1: Socio-economic practices	X203	0.831	0.930	0.933	0.607
	X205	0.816			
	X208*	0.805			
	X202	0.802			
	X206	0.789			
	X301*	0.787			
	X303	0.785			
	X204	0.785			
	X306	0.767			
	X307*	0.740			
	X207	0.712			
	X302	0.640			
Factor 2: Environmental practices	X104	0.933	0.979	0.978	0.865
	X107	0.920			
	X109	0.915			
	X105	0.912			
	X108	0.904			
	X103	0.849			
	X102	0.841			
Factor 3: Supplier management practices	X111	0.891	0.971	0.973	0.923
	X112	0.864			
	X110	0.860			

* Removed after CFA

Table III: SCR Measurement Model Assessment

Factors	Items	Standardized Factor Loadings	Cronbach's α	CR	AVE
SCR	Y106	0.896	0.936	0.938	0.684
	Y103	0.885			
	Y104	0.865			
	Y101	0.859			
	Y105	0.835			
	Y107	0.819			
	Y102	0.798			

Hypothesis Testing

For testing the research hypothesis H1, a multiple regression model was analysed with the SCR as the dependent variable and the three SSCM factors (socio-economic practices, environmental practices, and supplier management practices) as the independent variables. The results (shown in table IV) indicated statistical significance for the overall model with R^2 of 73.9% which supports the main research hypothesis. Moreover, the results show positive and statistically significant effect of each SSCM factor on SCR which highlighted the robustness of the theoretical framework underpinning the study.

Table IV - Regression Analysis (SCI and OP)

Independent Variables	Unstandardized Coefficients	t	Sig.	Model R^2	Model F
(Constant)	1.196	9.338	0.000	0.739	
Socio-Economic	0.525	14.330	0.000		157.071
Environmental	0.107	3.620	0.000		(p = 0.000)
Supplier Management	0.066	2.756	0.006		

Dependent Variable: SCR

Discussion and Conclusion

This research examined the relationship between SSCM practices and SCR. The research provides detailed conceptualization to the examined constructs as well as detailed explanation to the relationship between them.

The analysis provides a new operationalization approach for the SSCM practices within the manufacturing context of a developing country, Egypt. This construct was categorized into three factors, factor 1: socio-economic practices, factor 2: environmental practices and factor 3: supplier management practices. This classification highlighted two important issues. First, merging social and economic practices within a single factor. This factor contradicts with previous studies (Baliga et al., 2020; Hong et al., 2018; Michel-Villarreal, 2023; Saqib & Zhang, 2021) that separated social practices from economic practices. This may be attributed to the respondents' believe that social practices such as contribution to local community charitable donations should be implemented in conjunction with other economic practices such as building long-term relationships with partners.

Second, separating supplier management practices from internal environmental management practices. This factor extends the previously adopted view of considering all environmental practices as a single construct as mentioned in (Kot, 2018; Michel-Villarreal, 2023). However, this classification supports the approach of (Baliga et al., 2020) who classified green supply chain practices into internal and external practices.

Regarding the relationship between SSCM practices and SCR, the analysis results supported the main research hypothesis that all SSCM practices have direct positive effect on enhancing SCR. These findings resonate strongly with the insights put forth by previous studies conducted by Eggert & Hartmann (2022), and Bastas & Garza-Reyes (2022). These insights are in line with the recommendations proposed by Ali et al. (2022) who has advocated for the adoption of sustainable practices as a means of building resilience in supply chains.

In summary, this research builds upon and extends the findings of previous studies by providing empirical evidence to support the theoretical frameworks proposed by scholars such as Eggert & Hartmann (2022), Ali et al. (2022), Bastas & Garza-Reyes (2022), Chowdhury & Quaddus (2017), Chunsheng et al. (2020), Kumar & Anbanandam (2020), and Um & Han (2021). By corroborating these insights through rigorous quantitative analysis, this study contributes to a deeper understanding of the relationship between SSCM practices and SCR, thereby offering valuable implications for both theory and practice in the field of supply chain management.

Limitations and Future Research

The study, while offering significant insights into the relationship between SSCM (SSCM) practices, SCR (SCR) within the Egyptian manufacturing sector, is not without its limitations. Acknowledging these limitations provides a foundation for delineating avenues for future research.

The research was confined to the Egyptian manufacturing sector. Although this focus offers in-depth insights into this context, it may limit the generalizability of the findings to other sectors or geographical regions. Future studies could benefit from exploring similar models in different industries or countries. Also, the study's cross-sectional nature provides a snapshot of the relationships between SSCM practices and SCR. However, it does not capture how these relationships evolve over time. Longitudinal studies could offer deeper insights into the dynamic nature of these relationships. Besides, as the exploratory nature of this study, it focuses on examining the direct relationship between SSCM practices and SCR, but it does not consider how or what factors could affect this relationship. Thus, future studies could investigate the effect of potential moderators and mediators to offer a more nuanced understanding of the conditions under which SSCM practices most effectively enhance SCR.

Moreover, given the evolving nature of global supply chains, future research could examine how sudden disruptions (e.g., pandemics, natural disasters) affect the relationship between SSCM practices

and SCR, potentially identifying strategies that enhance resilience in the face of such challenges. While the study employed validated scales for measuring the constructs, there is always a possibility of measurement error or the existence of unmeasured facets of these complex constructs. Future research could explore alternative or additional measures to capture the full spectrum of SSCM practices and SCR.

This study sample represents different manufacturing companies in a developing country. Future research could undertake comparative studies that explore the SSCM-SCR relationship across different industries or countries. Furthermore, incorporating qualitative methods, such as case studies or interviews, could enrich the quantitative findings and provide deeper insights into the mechanisms through which SSCM practices affect SCR.

Practical Implications

This research illuminates a significant practical contribution to the Egyptian manufacturing sector by revealing the pivotal role that SSCM (SSCM) practices play in enhancing SCR (SCR).

The positive association between SSCM practices and SCR suggests that Egyptian manufacturing firms can significantly benefit from integrating sustainability principles into their supply chain operations. This integration not only contributes to global sustainability efforts but also provides a competitive edge by increasing the resilience of supply chains.

In summary, the practical contribution of this research to the Egyptian manufacturing sector lies in its clear delineation of a pathway towards achieving both resilience and sustainability. By embracing the insights provided by this study, manufacturing firms in Egypt can navigate the challenges of the 21st century with greater confidence, ensuring long-term success.

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