Building Sustainable Retailers: How Supply Chain Resilience and Principles of Circular Economy Drive Matter

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ABSTRACT

Manuscript type: Research paper

Research aims: This study aims to examine the impact of supply chain integration on sustainable performance in the Malaysian retail sector. It specifically investigates the role of supply chain resilience and the principle of circular economy as mediators in the relationship between supply chain integration and sustainable performance.

Design/Methodology/Approach: Data were collected from 110 large retail firms in Malaysia and analysed using partial least squares structural equation modelling (PLS-SEM) with SmartPLS 4.

Research findings: Both supply chain resilience and principle circular economy are found to significantly improve sustainable performance, jointly explaining 46.3% of the variance in sustainability outcomes. Surprisingly, this study found insubstantial evidence to support the relationship between supply chain integration and supply chain resilience. Furthermore, mediation analysis confirms that supply chain integration influences sustainable performance indirectly through supply chain resilience and principle circular economy.

Theoretical Contribution/Originality: This study extends the existing literature by incorporating mediators, namely supply chain resilience and principles of the circular economy. It also supplements the literature on sustainable performance by providing empirical evidence on circular economy practices from the perspective of the retail industry.

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Practitioner/Policy Implication: The findings of this study highlight that sustainable performance in today's disrupted environment depends not on integration alone, but on retailers' ability to reconfigure integrated supply chains into resilient and circular systems that can withstand uncertainty and resource scarcity. For policymakers, the findings indicate that policies promoting sustainability and circular economy practices should be complemented with initiatives that support supply chain capability development.
Research limitation/Implications: Since this study adopts cross-sectional research designs, the results may not be able to capture the dynamic evolution of supply chain integration, resilience and circular economy of retailers over a specific time frame.

Keywords: Retailers, Sustainable Performance, Circular Economy, Malaysia.
JEL classification: Q53, M11

1. Introduction

Retailing industry plays an important role in stimulating the national and global economies. In Malaysia, the retailing sector was valued at USD 125.76 billion in 2025 and is expected to reach USD 150.39 billion by 2030, due to increased consumer spending (Mordor Intelligence, 2025). From the socioeconomic perspective, this sector emerges as one of Malaysia's largest employers, whereby it provides jobs across all skill levels. Despite the importance of this sector to the country's economy, it faces growing challenges. Among them are rising operating costs, supply chain disruptions and volatile consumer demands. Recently, consumers are increasingly preferring to shop at retail stores that demonstrate ethical sourcing, waste reduction, fair labour practices and transparent sustainability commitments (Ghouse et al., 2025; Shimul et al., 2022). This situation, therefore, highlights the urgency of retailers to enhance their sustainable performance, as this would help in enhancing brand reputation, increasing customer loyalty and competitiveness in the market.

Sustainability has also become an important agenda for retailers as they manage complex supply chains that contribute significantly to carbon emissions, packaging waste and resource consumption. For example, in the retail industry, it is common for them to accumulate dead stock, which not only has an impact on their economic performance, but also leads to environmental problems. Inventory items left in the storage for extended periods would become obsolete and need to be disposed of through landfilling methods, which release harmful chemicals (DeVoy et al., 2021; Li et

al., 2023). Therefore, improving environmental performance through sustainable business practices helps retailers to reduce operational costs and align with the global sustainability agenda. Since retailers also act as influential gatekeepers in the supply chain, their sustainability requirements shape the practices of upstream suppliers and downstream consumers.

Existing literature widely acknowledges that supply chain integration plays an important role in enhancing sustainable performance across economic, environmental, and social dimensions (Wang et al., 2024; Oubrahim et al., 2023). The importance of supply chain integration was emphasised during COVID-19, when businesses were challenged by supply shortages, logistics delays and production disruptions, which affected their sustainable performance. Under such volatile conditions, supply chain integration ensures better visibility into stock levels, production capacity, lead times and potential disruptions. A strong integration with supply chain partners also helps the firms to identify alternative suppliers more quickly, negotiate flexibility arrangements and manage risks collectively, which reduces the impact of supply chain disruptions (Li & Thurasamy, 2025). Despite these, there are studies that show weak and insignificant relationships between supply chain integration and sustainable performance (Laari et al., 2016; Du et al., 2018; Shin et al.,2019). These inconsistencies suggest that supply chain integration may not influence sustainable performance directly, but rather through intervening mechanisms that enable firms to fully translate integration capabilities into sustainability outcomes.

To address this gap, the present study incorporates two intervening variables, namely principles of circular economy and supply chain resilience, as mediators in the relationship between supply chain integration and sustainable performance. Embedding circularity into retail businesses can reduce dependency on finite resources and avoid landfill overflow and unnecessary greenhouse gas emissions (Yang et al., 2017). Similarly, supply chain resilience has also become a critical capability for retailers operating in dynamic and disruption-prone environments. Resilient supply chains can anticipate, absorb, and recover from shocks, thereby ensuring continuity and sustainable performance (Mohezar et al., 2023). Including both circular economic principles and supply chain resilience, therefore, provides a more comprehensive understanding of how supply chain integration leads to sustainable performance, helping to explain the inconsistencies found in prior research and offering a more holistic perspective for the retail sector.

2. Literature Review

2.1 Underpinning Theory

This study is grounded in Dynamic Capability Theory (DCT), which explains how firms purposefully integrate, build, and reconfigure internal and external capabilities to address rapidly changing environments (Teece et al., 1997). Unlike the Resource-Based View (RBV), which emphasises ownership of valuable and unique resources, DCT focuses on the firm's ability to adapt, transform, and renew those resources in response to environmental uncertainty (Teece, 2014). This perspective is particularly relevant in the retail industry since firms operating in this sector are exposed to volatile markets that are shaped by supply uncertainties, regulatory pressures and increasing sustainability expectations from stakeholders in the supply chains. For instance, Mohezar et al. (2023) found that the changing demand patterns during the movement control order (MCO) forced the food retailing managers to mobilise their resources accordingly as a response to the disruptions. Adjustments must be made to cope with the challenges faced at that time. In another case, Lu et al. (2024) indicated that adopting sustainability practices in supply chain management requires firms to incorporate dynamic changes in their businesses. They need to redesign their procurement systems, logistics operations, customer engagement and supplier collaboration to ensure that they follow the circular economic principles, especially if they must align with respective legislative requirements from governments. Firms that can sense the disruptions, seize opportunities and reconfigure their operations are expected to be more capable of sustaining their businesses. Hence, DCT provides a robust theoretical grounding for examining how supply chain integration, circular economy principles, and supply chain resilience jointly explain sustainable performance.

2.2 Sustainable Performance of the Retailing Industry

Sustainable performance in the retailing sector refers to the ability of retailers to achieve long-term economic success while simultaneously fulfilling environmental responsibilities and social obligations (Giang & Dung, 2025). Unlike manufacturing firms, retailers occupy a strategic position at the interface between manufacturers and consumers, giving them significant influence over sustainability outcomes across the entire supply chain. Due to this, sustainability is now recognised as an essential target for the retail industry as part of the efforts towards achieving SDG number 12, which touches on

responsible production and consumption (Arora & Mishra, 2023; Nangia et al., 2024).

Under the environmental component, retail operations contribute substantially to environmental degradation through reduction in packaging waste, energy consumption and transportation emissions (Cheah et al., 2018a). In the U.K., it was reported that the British Retail Consortium (BRC) has formulated a climate action roadmap to facilitate retailers in achieving sustainable performance (Olanrewaju et al., 2024). Given this, many retailers in the U.K are taking several initiatives, including embracing renewable energy sources, implementing ethical sourcing practices, using energy-efficient buildings, and adopting eco-friendly packaging materials. Reducing waste also helps them to control costs and improve operational efficiency to remain viable (Cao & Mu, 2022). Retailers that use biodegradable or recycled products also appeal to a broader client base that values environmentally friendly operations (Walker et al., 2023). By using eco-friendly packaging, retailers can distinguish themselves in a crowded market. Under the social sustainability pillar, retailers achieve social performance when they emphasise the protection of human rights, employee well-being and community development. According to Olenwaraju et al. (2024), food retailers in the U.K are able to attract top talent and boost employee morale if they adopt energy efficiency-related practices. For many younger professionals (Millennials, Gen Z) and talent with strong environmental values, working for a "green" company is a key attraction.

2.3 Circular Economy in the Retail Industry

With the increasing sustainable development issues, the principle of the circular economy is gaining relevance in business thinking. A circular economy is referred to as an economic system that replaces the "end-of-life" or linear model concept with a business model that operates on reducing, reusing, recycling and recovering materials in production, distribution and consumption processes (Kirchherr et al., 2017). While this concept has been applied to many business sectors, its application in retailing is expected to produce high impact in the coming years (Uribe-Toril et al., 2022). According to Deloitte (2017)'s report, in Europe, 25 top retailers have publicly indicated their commitment to move towards the circular economy principle. Since millions of consumers buy products in their stores every day, and they contribute significantly to waste production, they are required to change their operations to be more sustainable.

Despite the importance of the circular economy in the retail industry, academic studies that focus on this area remain scarce. An earlier study, which was conducted by Mirabella et al. (2014), focused on the goal of a zero-waste economy in retailing. Following this research, few other studies have emphasised the critical role of retailers in preventing food waste through marketing and sales strategies and innovation (Borrello et al., 2017; Kazancoglu et al., 2022). Some studies explore the concept of circular economy in the fashion industry (Silva et al., 2025; Zaidi & Chandra, 2025). These studies argue that retailers are uniquely positioned to implement circular economy strategies because they influence product design, packaging, supplier selection, and consumer behaviour. Through coordinated supply chain activities, retailers can promote closed-loop systems that support sustainability across the value chain. They highlight that the current linear model seems to be the driver of environmental problems, particularly plastic accumulation and climate change.

2.3 Resilience in Retailers' Supply Chains

Resilience can be referred to as the capability of a supply chain to anticipate, prepare for, respond to, and recover from unexpected disruptions while maintaining its level of connectivity and operational continuity (Shishodia et al., 2023). The retail industry, specifically, is vulnerable to supply chain disruptions due to its high dependence on product variety, time-sensitive inventories, and geographically dispersed supplier networks. Retailers face frequent exposure to risks such as demand volatility, supplier failures, transportation delays, regulatory changes, and external shocks (Liu & Ren, 2025). These challenges make supply chain resilience a critical organisational capability for ensuring service continuity and competitive survival in retail environments.

Literature highlights that resilience in retail supply chains is commonly developed through multiple strategies, namely supplier diversification (Wang et al., 2024), inventory buffers (Kouvelis et al., 2023; Saarinen et al., 2024), flexible logistics arrangements (Ngah et al., 2023), digital integration (Huang et al., 2025) and contingency planning (Childs et al., 2022). In addition to examining resilience strategies, scholars have identified numerous barriers that hinder the development of resilient supply chains. These obstacles often arise from misaligned goals across supply chain partners, weak coordination, resistance to change, and limited information sharing. Such barriers can delay responses to disruptions and weaken

organisational preparedness (Talapatra et al., 2019). Together, these studies demonstrate that supply chain resilience is not merely a technical capability but a strategic necessity in turbulent business environments.

2.4 Conceptual and Hypotheses Development

Based on the literature review, six hypotheses are identified that outline the causal relationship between supply chain integration, supply chain resilience, adoption of principles of circular economy, and sustainable performance.

In line with Munir et al. (2022), this study conceptualises supply chain integration as three dimensions reflecting the degree of integration within the organisation, suppliers and customers. Several studies have optimistically found the effect of supply chain integration on supply chain resilience, through visibility (Scholten et al., 2020; Shi et al., 2022). Zhuo et al. (2021) suggest that supply chain actors should communicate effectively and collaborate to create plans for increased resilience. Through collaboration, firms can find new sources of raw material supply and get quick and real-time information about markets, customers and products, enhancing their resilience capability (Zulu-Chisanga et al., 2021). In the current digital environment, digital technologies such as the Internet of Things and blockchain, in supply chains, reflect good integration among businesses in the network (Kazancoglu et al. 2023). Based on these arguments, this study postulates that:

H_1: Supply chain integration is positively related to supply chain resilience

Embedding circular economy principles into supply chains introduces unique risks (Batista et al., 2023; Bodar et al., 2018). From the supply side, retailers may face risks related to the availability and quality of second-hand materials and products, which may expose businesses to uncertainties and vulnerabilities (Cimprich et al. 2023). On the demand side, risks can be driven by customer dissatisfaction, price and demand volatility in the market, and ambiguous policies (Ethirajan et al. 2021; Tuni et al. 2024). This situation thus places supply chain integration as an important mechanism to reduce the risks associated with circular economy practices. Through supplier integration, firms can work closely with upstream partners to ensure the sourcing of sustainable materials, improve packaging design, and adopt environmentally responsible production methods. Based on these arguments, this study postulates that:

H_2: Supply chain integration is positively related to principles of the circular economy

Studies have consistently demonstrated that the adoption of circular economy principles positively influences sustainable performance (Jabbour et al., 2020; Cullen & De Angelis, 2021). By emphasising resource efficiency and waste minimisation, firms can reduce ecological impact and improve environmental outcomes. In addition, circular economy practices support sustainability beyond environmental performance by encouraging innovation through advanced technologies and new business models, fostering regional economic development, and promoting social inclusion, thereby generating new employment opportunities (Lim et al., 2022). Given the retailer's central role as an intermediary between suppliers and consumers, the adoption of the circular economy principle is particularly critical in influencing sustainable outcomes throughout the supply chain. Based on the above arguments, this study postulates that:

H_3: Principles of circular economy are positively related to sustainable performance

Empirical evidence suggests that there is a relationship between resilience and the sustainability of a firm (Jabbarzadeh et al., 2018). Retailers with resilient supply chains are better equipped to manage demand volatility, supplier failures, and logistics disruptions, which help stabilise cash flows, protect market share, and enhance long-term profitability (Mehmood et al., 2025). When supply chains are unprepared, firms often resort to carbon-intensive emergency responses such as rush shipping, excess inventory disposal, or reliance on unsustainable suppliers, thereby increasing environmental damage caused by reactive operations (Hasan Al-Obaidy et al., 2025). Based on these arguments, this study postulates that:

H_4: Supply chain resilience is positively related to sustainable performance

The relationship between supply chain integration and sustainable performance is not necessarily linear (Wang et al.,2024). While supply chain integration improves coordination and information sharing, its impact on sustainability outcomes depends largely on how effectively firms translate integration capabilities into adaptive responses during periods of uncertainty. From a DCT perspective, supply chain integration represents coordination capability, whereas resilience reflects an adaptive capability that enables firms to reconfigure resources under turbulent conditions. Integration alone

cannot guarantee sustainability unless it strengthens the firm's responsiveness, flexibility, and capacity recovery (Ivanov, 2021; Queiroz et al., 2022). Without resilience, disruptions may force firms to prioritise short-term survival over sustainability commitments, leading to increased waste, emissions, and labour instability. Thus, supply chain resilience serves as a critical mechanism through which supply chain integration contributes to long-term sustainable performance. Based on these arguments, this study postulates that:

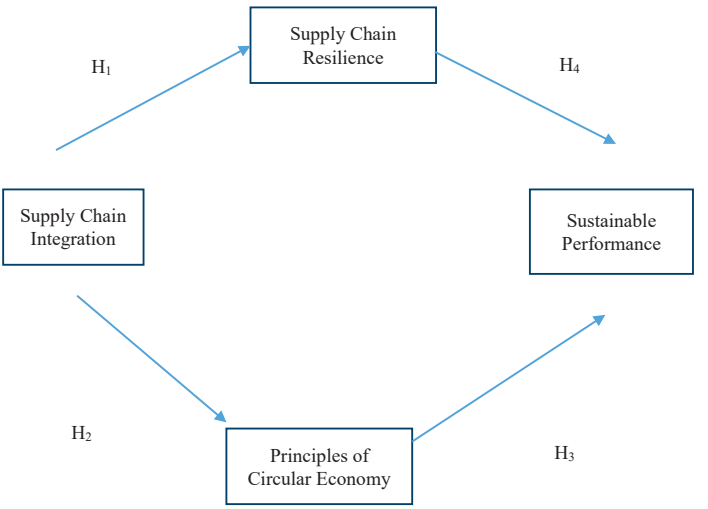
H_5: *Supply chain resilience mediates the relationship between supply chain integration and sustainable performance*

The effect of supply chain integration on sustainable performance is also mediated through a firm's ability to adopt and implement the circular economy (Chowdhury et al., 2023). From the perspective of DCT, circular economy adoption reflects a transformational capability that enables firms to redesign processes and resources toward sustainability objectives. Supply chain integration provides the operational foundation necessary for the circular economy by enabling coordination across suppliers, internal functions, and customers. Integrated supply chains facilitate the exchange of environmental information, synchronisation of production and logistics activities, and the development of closed-loop systems (Magnano et al., 2024). Based on these arguments, this study postulates that:

H_6: *Principles of circular economy mediate the relationship between supply chain integration and sustainable performance*

Given the hypotheses developed, Figure 1 illustrates the conceptual framework of this study.

Figure 1: Conceptual Framework



H5 and H6 are mediating relationships

3. Methodology

To measure each variable in the conceptual framework, this study developed a questionnaire, based on adapted multiple items from the literature (Appendix 1). A pilot study with a sample of 30 retailers in Malaysia was conducted to refine the questionnaire. The targeted population for this study consists of retail trade companies in Malaysia. As of 2025, the number of firms operating under the categories of Wholesale and Retail Trade was 475,566 (Department of Statistics, 2025). In this study, sampling frame was taken from firms listed in Bursa Malaysia, Malaysia Retail Chain Association (MRCA), Bumiputra Retailers Association (BRO), ASEAN Retail-Chains and Franchise Federation (ARFF), Branding Association Malaysia (BAM), Malaysia Franchise Association, Bumiputra Retailers Association (BRO). All firms were merged into a master list, and duplicates were removed manually to produce a final sampling frame, consisting of 1270 establishments. Aligning with Li et al. (2005), this study only includes firms with more than 100 employees, since firms with fewer than this number are less likely to have sophisticated enough supply chain management practices.

Systematic random sampling was then applied by selecting every fourth firm from the alphabetically ordered consolidated list, yielding a total of 300 firms. The unit of analysis for this study is the

organisation. Key respondents comprise senior managers (CEO/ president/COO/general manager) or middle-level managers from supply chain, operation, or sustainability, as to suit the context of the study. A two-stage contact approach was used. In the first stage, an invitation email explaining the purpose of the study was sent to prospective respondents to obtain voluntary participation consent. In the second stage, the survey link was emailed only to respondents who agreed to participate. This approach ensures ethical compliance, voluntary participation, and improved response quality. Only one respondent was selected to represent each company. Since the robustness of samples depends on a careful selection of respondents rather than their size, three inclusionary criteria questions are set at the beginning of the survey questionnaire. These include: 1. The company is in the retail industry (Offline/ online or both); 2. The business must be established in the year 2018 or before; and 3. The company has the following business units/departments: supply chain/ procurement/ purchasing/ buyer/merchandising. To increase the response rate, a follow-up phone call or email was made after two weeks of questionnaire distribution. Out of the 300 questionnaires that were sent out, 110 were returned, which brought a response rate of 36.7 per cent. As the response rate was only 36.7%, this study conducted an independent t-test, in which the responses of the early and late respondents were compared to determine non-response bias (Armstrong & Overton, 1977). Respondents who completed the questionnaires within one month were categorised as early respondents, while the rest were categorised as late respondents. The results of the independent t-test show that the p-values are more than 0.05, indicating no issues of non-response bias. Table 1 presents the profiles of the respondents.

Table 1: Respondents Profiles

Category		Frequency	Per cent (%)
Age of Company	2 – 5 years	7	6.3
	6 – 10 years	10	9.1
	11 - 15 years	11	10
	16 - 20 years	8	7.3
	More than 20 years	74	67.3
Size of Company - Number of Employees	101 - 200	24	21.8
	201 - 500	32	29.1
	501- 1000	14	12.7
	more than 1001	40	36.4

Category		Frequency	Per cent (%)
Type of Retail Store	Only Physical Store (Brick and Mortar)	17	15.5
	Only Online Store	1	0.9
	Both Physical and Online Store	92	83.6
Business Category	Beauty / Cosmetics	9	8.2
	Food & Beverage	38	34.5
	Convenience stores	7	6.4
	Department stores	4	3.6
	E&E appliances / Telecommunications	4	3.6
	Drug Stores (Pharmacy)	8	7.3
	Fashion and accessories	25	22.7
	Furniture and Home Improvement	7	6.4
	Supermarkets	8	7.3

The majority of the companies have been established for more than 20 years, with more than 1000 employees. More than half of them (83.6 per cent) have both physical and online stores. Almost 35 per cent of respondents are in the food and beverage sector.

Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed using SmartPLS 4 to analyse the proposed measurement and structural models. PLS-SEM was considered appropriate for this study due to its suitability for predictive analysis, complex models, and its flexibility in handling data that may not meet multivariate normality assumptions (Chin, 1998).

4. Results

To deal with the possible problem of common method bias occurring from a single source of data, a marker variable test was employed (Lindell & Whitney, 2001). The inclusion of the theoretically unrelated latent marker variable (Miller-Goldwater & Simmering, 2022) had minimal impact on the R-square values of the principal constructs, resulting in a difference of less than 10 per cent (Table 2). Thus, the analysis exhibits that the single-source bias is not a significant concern within the study dataset.

Table 2: Common Method Bias Testing - Changes in R- Square Values

Endogenous Constructs	Baseline Model (R^2)	Method Factor Model (R^2)	Per Cent (%) Change
SCR	0.122	0.122	0.00
PCE	0.109	0.113	3.67
ECP	0.210	0.210	0.00
ENP	0.313	0.342	9.27
SOP	0.369	0.382	3.52

4.1 Measurement Model – Lower Order Constructs

In line with Anderson and Gerbing (1988), we examined the model developed using a 2-step approach. First, we tested the measurement model to examine the convergent validity and discriminant validity of the instruments used (Hair et al., 2022). In the second stage, we ran the structural model to test the hypothesis developed. Several indicators were used as a basis to determine the convergent validity, which include factor loadings, composite reliability and average variance extracted (AVE). All variables achieve the composite reliability values of greater than 0.7, AVE value of greater than 0.6 and factor loading of more than 0.5 (Table 3), indicating a good convergent validity (Hair et al., 2022).

Table 3: Measurement Model for the Lower Order Constructs

Lower Order Constructs	Items	Loadings	CR	AVE
Supply Chain Integration (SUPPLY CHAIN INTEGRATION) (Higher Order Construct)				
Supplier Integration (SI)	SCI 1	0.687	0.862	0.556
	SCI 2	0.819		
	SCI 3	0.775		
	SCI 4	0.672		
	SCI 5	0.765		
Customer Integration (CI)	SCI 6	0.797	0.839	0.635
	SCI 7	0.830		
	SCI 8	0.761		
Internal Integration (II)	SCI 9	0.818	0.897	0.687
	SCI 10	0.879		
	SCI 11	0.783		
	SCI 12	0.832		

Lower Order Constructs	Items	Loadings	CR	AVE
Supply Chain Resilience (SCR)	SCR1	0.746	0.932	0.696
	SCR2	0.803		
	SCR3	0.848		
	SCR4	0.882		
	SCR5	0.859		
	SCR6	0.858		
Principles of Circular Economy (PCE)	PCE1	0.790	0.886	0.567
	PCE2	0.676		
	PCE3	0.834		
	PCE4	0.819		
	PCE5	0.702		
	PCE6	0.681		
Sustainable Performance (SP) (Higher Order Construct)				
Economic Performance (ECP)	ECP1	0.873	0.966	0.852
	ECP2	0.938		
	ECP3	0.958		
	ECP4	0.958		
	ECP5	0.883		
Environmental Performance (ENP)	ENP1	0.883	0.934	0.740
	ENP2	0.851		
	ENP3	0.816		
	ENP4	0.903		
	ENP5	0.846		
Social Performance (SOP)	SOP1	0.818	0.950	0.792
	SOP2	0.917		
	SOP3	0.867		
	SOP4	0.938		
	SOP5	0.904		

Next, we assessed the discriminant validity using the HTMT criterion suggested by Henseler et al. (2015) and Franke and Sarstedt (2019). The values of HTMT for all the variables are lower than 0.85, demonstrating that the discriminant validity is established (Table 4).

Table 4: Discriminant Validity = HTMT Ratio

Constructs	CI	ECP	ENP	II	PCE	SOP	SI	SCR
CI								
ECP	0.265							
ENP	0.337	0.246						
II	0.796	0.270	0.342					
PCE	0.368	0.376	0.592	0.246				
SOP	0.213	0.382	0.727	0.330	0.534			
SI	0.836	0.208	0.301	0.727	0.350	0.175		
SCR	0.350	0.424	0.391	0.356	0.420	0.560	0.214	

Note: CI= Customer Integration; ECP= Economic Performance; ENP= Environmental Performance; II= Internal Integration; PCE= Principles of Circular Economy; SOP= Social Performance; SI= Supplier Integration; SCR= Supply Chain Resilience.

4.2 Measurement Model – Higher Order Constructs

Since the framework consists of two constructs which are higher order (reflective- formative), namely Supply Chain Integration and Sustainable Performance, the validity and reliability of the second-order constructs were also examined. As shown in Table 5, the higher-order measurements are also valid and reliable.

In stage 1, we conducted redundancy analysis to determine the appropriateness of supply chain integration and sustainable performance as a higher-order reflective-formative construct. This analysis helps in establishing the convergent validity (Chin, 1998). In formative measurement model evaluation, convergent validity refers to the degree to which the formatively specified construct correlates with an alternative reflectively measured variable (s) of the same concept. To execute this procedure for determining convergent validity, an alternative measure for the formatively measured construct was included in the questionnaire. Cheah et al. (2018) show that a global single item, which captures the essence of the construct under consideration, is generally sufficient as an alternative measure. For the supply chain integration construct, this analysis yields a path coefficient of 0.824, whereas SP at 0.773, both achieving the recommended threshold of 0.708 (Hair et el., 2022). Next, the collinearity was assessed. To check the formative model's collinearity issues, Variance Inflation Factor (VIF) values were examined. In the present study, collinearity does not pose any threat, as the VIF values for the formative higher-order supply chain integration and SP constructs are less than the recommended value of 5 (Hair et al., 2022).

Next, statistical significance and relevance of outer weights are assessed. The outer weights are found to have a significant value (Hair et al., 2022) for customer integration for supply chain integration, while economic performance, environmental performance and social performance for sustainable performance. However, this study found an insignificant value for supply chain integration and internal integration for supply chain integration. Following this, we proceeded with outer loadings results, which are found to have a greater value than 0.50 and are significant for each of the indicators of the higher order formative internal marketing construct (Sarstedt et al., 2019). According to Hair et al. (2022), the indicators will be kept if outer loading is >= 0.5 although outer weight is not significant. Since all criteria are met (Table 5), the Higher Order Constructs' validity is established.

Table 5: Higher-order Construct (Reflective formative) Validity

HOCs	LOCs	Redundancy Analysis (Path Coefficient)	VIF	Outer Weights	t value	p value	Outer Loadings
Supply Chain Integration	SI	0.824	1.936	0.155	0.376	0.353	0.769
	CI		1.901	0.592	1.725	0.042	0.928
	II		1.867	0.391	0.868	0.193	0.848
Sustainable Performance	ECP	0.773	1.156	0.397	3.277	0.001	0.668
	ENP	1.839	0.370	1.989	0.023	0.800	
	SOP		2.000	0.493	2.520	0.006	0.889

4.3 Structural Model

Prior to structural model testing, we assessed the multivariate skewness and kurtosis (Hair et al., 2022). The results shows that the data is not multivariate normal (Mardia's multivariate skewness, $\beta = 29.953$, $p < 0.01$, and Mardia's multivariate kurtosis, $\beta = 116.901$, $p < 0.01$). Hence, this study performed a structural model using a 10,000-sample re-sample bootstrapping procedure (Hahn & Ang, 2017; Becker et al., 2022). Table 6 shows the results.

The R^2 of supply chain integration on supply chain resilience is 0.109, indicating that supply chain integration explained 10.9 per cent of the variance in supply chain resilience. A positive relationship between the two variables was found ($\beta = 0.330$, $p < 0.01$). However, since the confidence intervals bias corrected 95 per cent show an interval straddling 0 (BCI LL= - 0.077, BCI UL = 0.490), H_1 is not

supported. Next, we tested the effect of supply chain integration on the principle of the circular economy. The R^2 is 0.096, showing that supply chain integration explains 9.6 per cent of the variance in principles of circular economy. Both variables are positively related ($\beta = 0.310$, $p < 0.01$). The confidence intervals bias corrected 95 per cent does not show any intervals straddling at 0 (BCI LL= 0.010, BCI UL = 0.426), which supports H_2. Following this, we tested the effect of supply chain resilience and principles of circular economy on sustainable performance. R^2 is 0.463, which indicates that supply chain resilience and principles of the circular economy explains 46.3 per cent of the variance in sustainable performance. Both supply chain resilience ($\beta = 0.394$, $p < 0.01$) and the principle of circular economy ($\beta = 0.429$, $p < 0.01$) are positively related to sustainable performance. Furthermore, the confidence internals bias corrected 95 per cent does not show any intervals straddling 0, thus supporting H_3 and H_4.

Table 6: Hypothesis Testing Direct Effects

Hypothesis	Std Beta	Std Dev	t value	p value	BCI LL	BCI UL	Effect Size, f2	Results
H1	0.330	0.141	2.342	0.010	-0.077	0.490	0.122	Not Supported
H2	0.310	0.101	3.077	0.001	0.010	0.426	0.106	Supported
H3	0.394	0.105	3.743	0.000	0.199	0.550	0.251	Supported
H4	0.429	0.098	4.360	0.000	0.252	0.578	0.296	Supported

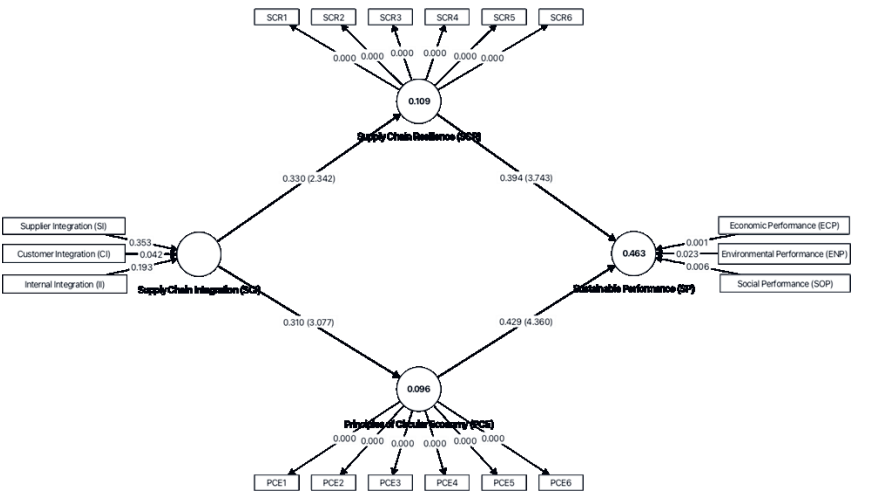
To test the mediation hypotheses, we followed the suggestions of Preacher and Hayes (2004, 2008) by bootstrapping the indirect effect. If the confidence interval does not straddle 0, then we can conclude that there is a significant mediation. As shown in Table 7, SCI → SCR → SP ($\beta = 0.130$, $p < 0.05$) and SCI → PCE → SP ($\beta = 0.133$, $p < 0.05$) are significant. The confidence intervals bias corrected 95 per cent also do not show any intervals straddling 0, thus confirming our findings. Thus, H_5 and H_6 are also supported.

Table 7: Hypothesis Testing Indirect Effects

Hypothesis	Std Beta	Std Dev	t value	p value	BCI LL	BCI UL	Effect Size, f2	Results
H5: SCI -> SCR- > SP	0.130	0.071	1.822	0.034	0.006	0.229	0.02	Supported
H6: SCI -> PCE -> SP	0.133	0.053	2.526	0.006	0.030	0.206	0.02	Supported

Notes: SCI – Supply Chain Integration, SCR – Supply Chain Resilience, SP – Sustainable Performance, PCE – Principles Circular Economy

Figure 2: Structural Model Analysis



Following this, a holdout sample-based prediction assessment was conducted using the PLS-Predict procedure with a 5-fold cross-validation approach to evaluate the model's predictive relevance (Shmueli et al., 2019). As shown in Table 10, the majority of the prediction errors (RMSE) generated by the PLS-SEM model are lower than those produced by the linear model (LM) for both principles of circular economy (PCE) and supply chain resilience (SCR), indicating moderate predictive power for these endogenous constructs. In addition to that, all prediction errors for sustainable performance dimensions (ECP, ENP, and SOP) are lower in the PLS-SEM model compared to the LM benchmark, suggesting strong predictive power of the model for sustainable performance.

Table 8: PLS- Predict

Endogenous	Q^2predict	PLS-SEM_ RMSE	LM_RMSE	PLS - LM RMSE	Predictive Power
PCE1	0.033	1.547	1.566	-0.019	
PCE2	-0.020	1.625	1.641	-0.016	
PCE3	-0.012	1.444	1.459	-0.015	**Medium**
PCE4	-0.007	1.564	1.579	-0.015	
PCE5	-0.072	1.557	1.543	0.014	
PCE6	0.015	1.389	1.397	-0.008	
SCR1	-0.031	1.169	1.212	-0.043	
SCR2	-0.018	1.114	1.164	-0.050	
SCR3	-0.094	1.195	1.153	0.042	**Medium**
SCR4	-0.072	1.172	1.147	0.025	
SCR5	-0.019	1.147	1.143	0.004	
SCR6	-0.058	1.084	1.087	-0.003	
ECP	0.013	1.008	1.054	-0.046	
ENP	0.052	0.988	1.012	-0.024	**High**
SOP	-0.015	1.020	1.036	-0.016	

5. Discussion

This study aims to understand the interaction among supply chain integration, supply chain resilience, principles of the circular economy, and sustainable performance. It specifically investigates how the relationship between supply chain integration and sustainable performance is mediated by both supply chain resilience and principles of the circular economy.

The findings reveal a nuanced picture. First, while the relationship between supply chain integration and supply chain resilience is positive ($\beta = 0.330$), the effect lacks robustness since the bias-corrected 95 per cent confidence interval straddles zero (BCI LL = −0.077, BCI UL = 0.490). This shows that while integrated processes may facilitate retailers during disruptions, integration alone is not sufficient to improve their resilience capacity. This result is found to be inconsistent with the previous literature (Scholten et al., 2020; Shi et al., 2022). While this is quite surprising, the results perhaps are more understandable when viewed through the lens of the operational structure of Malaysia's retail sector. Large retailers in Malaysia typically operate through centralised procurement and supply chain functions (Ong, 2025). Although this improves

coordination and control of business processes, it may not translate into resilience due to a lack of flexibility. While transparency achieved through integration facilitates retailers in recognising and monitoring disruptions, it does not necessarily build the firms' resilience (Aun et al., 2025). In reality, businesses deal with disruptions by relying on increased safety stock and dual or multi-sourcing. They typically act in isolation, with the visibility of the supply chain extending only to the immediate upstream or downstream tier (Scheibe & Blackhurst, 2018).

Secondly, this study found supply chain integration significantly influenced principles of circular economy adoption ($\beta = 0.310$), suggesting that integration drives circular economic behavioural transformation within Malaysia's retail sector. In Malaysia, circular economy adoption is still largely transitional rather than fully institutionalised, which has yet to match the developed countries (Shaharudin et al., 2025). They are starting to move beyond compliance-based toward more systematic practices along supply chains. In this context, integration is required across suppliers, internal and customers. For instance, enabling sustainable packaging initiatives requires close collaboration with suppliers to ensure the availability of appropriate and environmentally friendly inputs, while effective coordination with customers is essential to facilitate the return, reuse, or recycling of packaging materials after consumption. Thus, supply chain integration is critical as it helps reduce barriers between actors in the supply chain. This finding is consistent with previous studies (Massari et al., 2025).

Third, this study found both supply chain resilience ($\beta = 0.394$) and principles of circular economy ($\beta = 0.429$) significantly improve sustainable performance. This finding corroborates previous studies (Osei et al., 2025). This is not surprising, given the recent supply chain disruptions, which have heightened the need for retailers to have resilience capabilities. Retailers that are able to absorb shocks, recover quickly and reconfigure resources are better positioned to maintain service continuity, protect employees and safeguard customer trust (Mohezar et al., 2023). Given Malaysia's exposure to global supply fluctuations, import dependency, and extreme weather events, resilience naturally feeds into economic and social performance. In addition, the effect of principles of circular economy on sustainable performance also indicates the growing importance of environmental and circular practices in shaping today's retailers' performance. This indicates that initiatives such as waste reduction, energy efficiency, recycling, and sustainable product design not only reduce

environmental impact but also generate cost savings, enhance brand reputation, and improve stakeholder relationships. In Malaysia, where ESG disclosure requirements and sustainability reporting are becoming more prominent, firms that actively adopt circular economy principles are increasingly rewarded through improved market positioning and legitimacy (Mohammad & Wasiuzzaman, 2021).

Fourth, the mediation analysis shows that supply chain integration would translate into sustainable performance through two distinct yet complementary mechanisms, resilience and circular economy. While the direct supply chain integration and supply chain resilience relationship is not substantially evident in this study, the indirect pathway indicates that integration with supply chain partners as well as internal units plays a meaningful role by supporting resilience-related activities and processes, namely information sharing, communication and collaboration, especially during disruptions. This is aligned with the previous studies, which similarly emphasised that internal integration serves as the foundation for successful external integration as firms must first align internal information flows, decision-making processes, and operational objectives before coordinating effectively with supply chain partners (Du et al., 2018; Han & Huo, 2020). This demonstrates supply chain integration as a foundational enabler rather than a direct driver of resilience. This finding aligns with the dynamic capabilities, in which it shows that lower-order resources, such as integration, must be transformed into resilience capabilities before sustainable performance can be achieved (Teece, 2014). Retailers therefore need to continuously configure integration mechanisms rather than just depending on static supply chain integration. Once these capabilities are in place, they significantly enhance sustainable performance by maintaining operational continuity, protecting stakeholder relationships, and reducing the social and economic costs of disruptions.

6. Implications and Conclusions

This study offers several important theoretical contributions to the literature on supply chain integration, resilience, circular economy, and sustainable performance, particularly within the context of emerging economies. First, the findings of this study challenge existing literature by demonstrating an inconsistency in the relationship between supply chain integration and supply chain resilience. While previous studies largely report a positive and significant linkage, in this study, we observed that integration

alone may not be sufficient to enhance resilience, in the context that is characterised by centralised structures and asymmetric information flows. This shows that integration should not be treated as a universal resilience mechanism. This finding extends the DCT by providing evidence that not all dynamic capabilities translate into adaptive outcomes. Second, this study extends the DCT by empirically demonstrating supply chain integration as enabling capability that supports the implementation of circular economy practices instead of directly affecting sustainable performance. The study has also advanced the existing knowledge by empirically positioning supply chain integration as an enabling infrastructure for circular model transformation in the retail sector. In contrast with the previous studies of circular economy that have primarily focused on the manufacturing setting, this study demonstrates how retailers operationalise circular practices. It evidently shows that retailers are not merely downstream distributors, yet they can be active orchestrators of circular value creation within supply chains.

The findings of this study also offer several important implications for managers and policymakers within the retail sector. Since the static supply chain integration is insufficient to attain resilience, retailers should therefore move beyond establishing integrated relationships and focus on developing capabilities that allow supplier networks, internal processes, and customer engagement mechanisms to be flexibly adjusted over time. The significant role of integration in circular economy practice suggests that retailers need to leverage integration with supply chain partners and internal units to support material recirculation and resource efficiency. At the same time, coordination with customers should be enhanced to facilitate take-back schemes, recycling initiatives, and responsible consumption behaviours. These practices can reduce reliance on virgin materials and improve material availability, especially in an environment characterised by frequent supply disruptions. Given Malaysia's exposure to climate-related risks, import dependency, and global supply volatility, such investments are increasingly critical.

For policymakers, the findings indicate that policies promoting sustainability and circular economy practices should be complemented with initiatives that support supply chain capability development. Since supply chain integration drives the coordination required for circular practices, policymakers should establish shared data systems and digital platforms for product lifecycle tracking and information exchange to ensure effective reverse logistics between manufacturers, logistics providers, and recyclers.

While this study extends existing literature and provides implications for theory and practices, the findings are subject to several limitations that offer avenues for future research. Since the data were collected from large retail firms in Malaysia, the generalisability of the findings to other sectors or institutional contexts may be limited. Supply chain structures, regulatory environments, and sustainability maturity levels may differ across industries and countries. Future research could replicate the model in other sectors or conduct cross-country comparisons to explore how institutional and cultural factors condition the relationships between integration, resilience, circular economic practices, and performance. While this study conceptualises supply chain integration as a higher-order construct, it does not explicitly examine the reconfiguration of integration mechanisms over time. Future studies could further unpack this process by incorporating constructs such as supply chain agility, digitalisation, or adaptive governance to better capture the dynamic capabilities through which integration is transformed into resilience and circular outcomes.

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Appendix 1

Construct	Measurement Items	Source (s)
Supply Chain Integration (SCI)		
Supplier Integration (SI)	SCI1.We maintain cooperative relationships with our suppliers.	(Kumar et al., 2020)
	SCI2.We maintain close communications with suppliers about quality considerations and design changes.	
	SCI3.We strive to establish long-term relationships with suppliers.	
	SCI4.Our suppliers are actively involved in our new product development process.	
	SCI5.We actively engage suppliers in our quality improvement efforts.	
Customer Integration (CI)	SCI6.Our customers give us feedback on our quality and delivery performance.	
	SCI7.Our customers are actively involved in our product design process.	
	SCI8.We strive to be highly responsive to our customers' needs.	
Internal Integration (II)	SCI9.Departments in the company communicate frequently with each other.	
	SCI10.The functions in our company cooperate to solve conflicts between them when they arise.	
	SCI11. Our company's functions coordinate their activities.	
	SCI12. We work in teams, with members from a variety of areas (marketing, retail/operations, supply chain, etc.) to introduce new products.	

Construct	Measurement Items	Source (s)
Principles of Circular Economy (PCE)	PCE1. Replacement of non-renewable raw materials (plastic, non-eco-friendly material, etc) by renewable raw materials (clean energy – solar, bioenergy, rainwater, eco-friendly/ green material – FSC certified paper, biodegradable material for packaging, etc.).	(Chiappetta Jabbour et al., 2020)
	PCE2. Extending the product's lifecycle.	
	PCE3. Reduction of waste and rework.	
	PCE4. Initiatives of reuse, recycling, and remanufacturing.	
	PCE5. Development of new digital and internet-based products and services.	
	PCE6. Replacing current equipment and technologies with more modern and efficient ones.	
Supply Chain Resilience (SCRES)	*Readiness*	(Qader et al., 2022)
	SCR1. Our company (prior to disruptions) can eliminate the source of potential disruptions before they occur.	
	SCR2. Our company (prior to disruptions) monitors supply chain processes in advance to prevent potential disruptions.	
	Respond	
	SCR3. Our company (immediately after disruptions) can rapidly respond to actual disruptions.	
	SCR4. Our company (immediately after disruptions) can quickly recognise supply chain resources immediately after an actual disruption breaks out.	
	Recovery	
	SCR5. Our company can recover from disruptions in the supply chain.	
	SCR6. Our company can reconfigure supply chain resources after responding to disruptions in the supply chain.	

Construct	Measurement Items	Source (s)
Sustainable Performance (SP)		
Economic Performance (ECP)	ECP1. Growth in sales.	(Han & Huo, 2020)
	ECP2. Growth in profit.	
	ECP3. Growth in ROI.	
	ECP4. Growth in return on sales.	
	ECP5. Growth in market share.	
Environmental Performance (ENP)	ENP1. Reduction in air emissions.	(Paulraj, 2011)
	ENP2. Reduction in waste (water and/ or solid).	
	ENP3. Decrease in the consumption of hazardous/ harmful/toxic materials.	
	ENP4. Decrease in frequency for environmental accidents (reduced air pollution, oil spill, chemical spill, waste issue, etc.).	
	ENP5. Increase in energy saved due to conservation and efficiency improvements.	
Social Performance (SOP)	SOP1. Improvement in overall stakeholder welfare or betterment.	(Paulraj, 2011)
	SOP2. Improvement in community health and safety.	
	SOP3. Reduction in environmental impacts and risks to the general public.	
	SOP4. Improvement in occupational health and safety of employees.	
	SOP5. Improved awareness and protection of the claims and rights of people in the community served.	