

What Does Green Logistics Bring to the Circular Economy? An Exploratory Study to Connect the Dots

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Abstract: The world population has increased, and consumerist trends have intensified the need for initiatives to minimize industrial activities' environmental and social impacts. Companies and governments are increasingly recognizing the relevance of these initiatives, yet many firms still follow resource extraction models that hinder sustainability efforts. While previous studies have explored the link between green logistics and the circular economy, gaps remain in understanding how these practices can be leveraged to achieve a competitive advantage in different international contexts. This research aims to fill these gaps by exploring the role of green logistics in promoting the circular economy, using a quantitative approach based on Brazilian and Portuguese companies. The study, therefore, focuses on how logistics practices can support the adoption of circular economy initiatives, minimize environmental impacts, and contribute to competitive advantage. The findings from linear regression analysis indicate that green logistics significantly enhances the implementation of circular economy practices, providing both environmental benefits and strategic advantages in the market. This empirical evidence advances the literature by demonstrating that green logistics is not only crucial for circular economy adoption but also for gaining a competitive edge. Our insights are particularly valuable for academia, businesses, and policymakers seeking to promote sustainable practices that are both environmentally responsible and economically viable.

Keywords: Green Logistics, Circular Economy, Sustainability, Closed-loop Supply Chain, Regression Analysis

1. Introduction

The global economy has experienced substantial growth in recent years, driven by a significant increase in population and a corresponding rise in consumerism across several sectors, including technology, furniture, clothing, and food. While this economic expansion is generally seen as positive, the production and distribution of these goods have significantly contributed to environmental degradation (Eionet, 2016). This has led to an urgent need for sustainable practices, particularly in the logistics sector, which plays a crucial role in the circular economy by ensuring the efficient flow of products, materials, and information.

Logistics activities, often associated primarily with transportation, include a broad range of activities such as supplier management, warehousing, and distribution. The rapid expansion of online commerce has further amplified the logistics sector's contribution to worldwide environmental impacts (Popescu *et al.*, 2024). In this context, increasing concerns about the negative impacts of logistics have prompted companies to leverage these activities for future development trends within the framework of a circular economy. This approach aims to support companies in the reverse waste collection process between customers and industries (Blanco and Sheffi, 2024). However, despite the critical role of logistics in the circular economy, existing literature has not fully explored how sustainable logistics practices can be leveraged to achieve a competitive advantage, particularly in different international contexts.

Considering the contribution of linking the dots, this research explores the role of green logistics in promoting the circular economy and reducing environmental impact. More importantly, we investigate whether these sustainable logistics practices can confer a competitive advantage, a topic that has been underexplored in extant literature. Previous studies, such as those by Ly (2021) and Brogi and Menichini (2024), have highlighted the potential for circular economy practices to enhance competitiveness, but have not specifically focused on the logistics sector.

Similarly, sustainable supply chain management (SSCM) and the transition towards a circular economy are increasingly recognized as key drivers of competitive advantage. As highlighted by Genovese *et al.* (2017), SSCM facilitates the shift towards a circular economy by integrating environmental considerations into supply chain operations. This integration leads to the more efficient use of resources, reduction in waste, and the creation of closed-loop systems where materials are continuously reused and recycled. These practices not only contribute

to environmental sustainability but also offer significant economic benefits, such as cost savings through reduced material consumption and waste management expenses.

In light of the above, the research developed by Genovese *et al.* (2017) provides empirical evidence that companies transitioning towards circular economy models often experience improved brand reputation and customer loyalty, as consumers increasingly prefer companies that demonstrate environmental responsibility. This reputational advantage can translate into higher market share and profitability, thus reinforcing the competitive advantage. Accordingly, the dual focus on sustainability and competitiveness is particularly important as companies seek to align their operations with sustainable development goals (SDGs) while maintaining their market position.

The contributions of this paper are twofold. Firstly, it provides empirical evidence that green logistics can significantly enhance the adoption of circular economy practices. Secondly, it demonstrates that these practices not only contribute to environmental sustainability but also offer strategic advantages in the market. These findings are especially relevant for companies aiming to integrate circular economy principles into their operations as a means of achieving long-term competitiveness.

The remainder of this paper is organized as follows: section 2 highlights the importance of logistics and its link with circular economy and sustainability. Section 3 outlines the research path considered for this research, including the construction of the model and variables used as instruments in this research, followed by the analysis used. Section 4 presents the results of the analysis conducted. The paper ends by presenting the main conclusions and policy implications of this research.

2. Theoretical Background

Sustainable logistics, also known as green logistics, is defined as "*supply chain management practices and strategies that reduce the ecological and energy footprints of the distribution of goods, focusing on material handling, waste management, packaging, and transport*" (Seroka-Stolka and Ociepa-Kubicka, 2019, p. 472). Companies in the logistics sector are increasingly adopting sustainable practices to mitigate their contributions to environmental degradation, including carbon emissions, noise pollution, and resource depletion. Consequently, existing research largely focuses on Green Logistics (GL) practices, examining their benefits, barriers, indicators, drivers, and relationship to sustainability performance (Singh *et al.*, 2022).

Logistics, as a crucial activity that facilitates the circulation of goods, plays a pivotal role in the supply chain and significantly contributes to environmental impacts, including air pollution (De Souza *et al.*, 2022). Transportation, one of the core operations within logistics, is responsible for 24% of global carbon emissions (Ritchie, 2020). Implementing GL practices is essential for reducing emissions and conserving resources in support of a circular economy (Seroka-Stolka and Ociepa-Kubicka, 2019). Several scholars have identified GL practices across various categories aimed at these objectives (e.g., Evangelista *et al.*, 2017). These practices have a substantial impact on a firm's environmental performance, which, in turn, contributes to creating environmental value as a fundamental pillar of the circular economy (Jayarathna *et al.*, 2023).

GL practices also directly influence economic performance (De Souza *et al.*, 2022). For example, reducing energy consumption through modal shifts, eco-driving, the use of alternative energy sources, and fleet management can lead to significant cost savings (Sureeyatanapas *et al.*, 2018). Although the implementation of sustainable practices requires substantial financial investment, it enhances financial performance in the long term by providing cost-effective services and attracting more customers, which in turn increases market size, sales, and profitability (Agyabeng-Mensah *et al.*, 2020). Additionally, firms anticipate gaining a competitive advantage by adopting green practices (Vachon and Klassen, 2008).

In addition to economic and environmental benefits, GL practices also contribute to social benefits, positively impacting the well-being of employees and other stakeholders, including customers, suppliers, and society (Makov and Newman, 2016). Social practices such as health and safety measures, employee training and development, diversity initiatives, improving working conditions, and supporting community projects contribute to social performance (Kumar and Anbanandam, 2022). These practices play a crucial role in creating social value by fostering human and social capital, essential components of a circular economy (Padilla-Rivera *et al.*, 2020).

The concept of the circular economy was first introduced in Boulding's (1966) book "*The Economics of the Coming Spaceship Earth*". Boulding conceptualized *Earth* as a closed economic system in which the economy and environment are interlinked in a circular relationship. He argued that a linear economic system, characterized by resource extraction, production, and consumption, could be transformed into a circular

economy through waste recycling. This concept was further developed by Pearce and Turner (1990) in their book *“Economics of Natural Resources and the Environment”*, which illustrated the economic and ecological functions involved. Pearce and Turner (1990, p. 35) emphasized that *“if we ignore the environment, then the economy appears to be a linear system”*. In this linear system, every stage – resource extraction, production, and consumption – generates waste, some of which can be recycled, while much of it is discarded into the environment. They further highlighted that missed opportunities for recycling often result from a failure to create value within the supply chain.

In this context, closed-loop supply chains play a key role in fulfilling circular economy goals. A closed-loop supply chain is a circular supply chain model where traditional activities are integrated with reverse logistics processes to enhance operational efficiency and minimize waste generation (Zarbakhshnia *et al.*, 2023). By embedding the principles of the circular economy, which emphasizes the restoration and regeneration of resources, a closed-loop supply chain can enhance environmental performance by facilitating the return of products to producers and minimizing waste. Accordingly, the significance of logistics management in a supply chain network is becoming clearer (Zarbakhshnia *et al.*, 2023). To achieve the objectives of the circular economy through a closed-loop supply chain, firms must prioritize logistics operations in both forward and reverse flows (Figure 1).

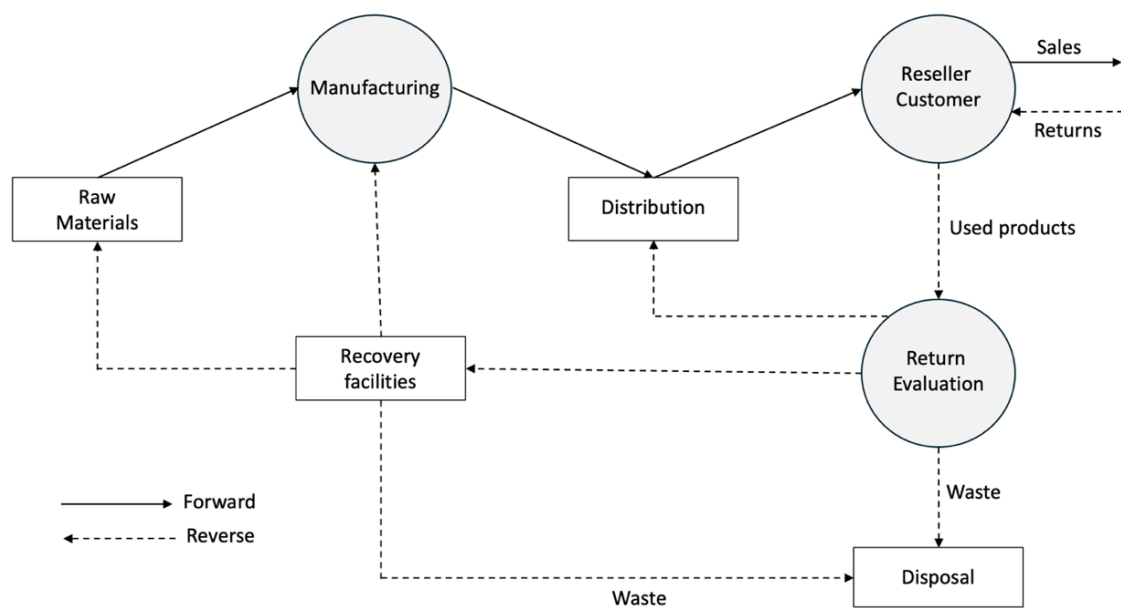


Figure 1: An overview of a closed-loop supply chain (adapted from Zarbakhshnia *et al.*, 2023)

As presented in Figure 1, recycling and disposal are the most significant activities of GL practices in the closed-loop supply chain. This is the main reason why several researchers believe that logistics operations can also be a sustainable and environmentally friendly strategy that allows achieving competitive advantage for companies but also accomplishing the purposes of circular economy and sustainable development (e.g., Sharma *et al.*, 2021). The concept and implementation of green GL practices and closed-loop supply chains contribute to reducing production costs and ultimately lowering final prices for consumers (Lima *et al.*, 2022). By using this strategy, not only the costs and usage of resources will be reduced, but also the environment will be protected (De Souza *et al.*, 2022). The current research thus included the following hypothesis:

Hypothesis (H): Sustainable logistics has a positive effect on the adoption of circular economy practices.

3. Methodology

3.1 Data Collection and Sample

In this research, a convenience sample technique was used to distribute the survey between July and December 2023 through the Google Forms platform. The use of this technique was primarily due to the accessibility of participants and the practical constraints associated with reaching a broader sample. While convenience sampling may limit the representativeness of the sample, it was deemed appropriate for this exploratory study.

The selection of Brazilian and Portuguese companies was based on their willingness to participate and their relevance to the study's focus on sustainable logistics and circular economy practices.

Brazil, as an emerging economy with significant industrial and agricultural sectors, presents a unique context where green logistics could play a crucial role in mitigating environmental impacts. On the other hand, Portugal, as a European Union (EU) member with a growing emphasis on sustainability and circular economy initiatives, offers a contrasting yet complementary context for examining these practices. This dual focus allows the study to explore sustainable logistics in diverse economic and regulatory environments, potentially revealing different challenges and opportunities.

By the end of the data collection period, the sample included answers from 14 Brazilian and Portuguese companies. This sample consists of small firms (between 10 and 50 employees; 14.29%) and medium-sized enterprises (between 50 and 250 employees; 85.71%). In this regard, it is worthwhile noting that the sample size is admittedly limited. While this small sample allows for an in-depth examination of the companies' practices, it also challenges the generalizability of the findings. Despite this limitation, the insights gained from this study are still valuable, particularly as an exploratory analysis in the field of sustainable logistics and circular economy practices.

To mitigate common method bias, well-tested scales were employed, and respondent confidentiality and anonymity were ensured. This bias, as outlined by Podsakoff *et al.* (2003), can occur when data is collected from the same source at a single time, leading to variance from the measurement method rather than the constructs being measured. To address this, Harman's single-factor test was conducted, and the results indicated that no single factor accounted for the majority of the variance, suggesting that common method bias was not a significant concern in this study.

3.2 Variables

The questionnaire used in this research was adapted from guidelines provided by the European Commission (2018), ensuring alignment with established standards for sustainability and circular economy practices, and it included three sections. The first contains general questions about the characterization of the companies, such as number of employees, sector of activity, and turnover. The second and third ones comprise six attributes for sustainable logistics and eight questions related to circular economy practices (see Table 1).

Table 1: Measures of sustainable logistics and circular economy practices

Latent Variable	Observed Variable
Sustainable Logistics	LOG1. Identification of new partners within the supply chain who prioritize environmental responsibility or use renewable resources.
	LOG2. Identification of by-products in supply chain processes to reduce waste and promote resource efficiency.
	LOG3. Identification of partners who use by-products or waste materials from the supply chain.
	LOG4. Improvement of transportation and work management.
	LOG5. Promotion of initiatives to stimulate the rational reuse of raw materials.
	LOG6. Adoption of new initiatives that include reverse cycle.
Circular Economy	CE1. Practices for reducing waste generation in the processes.
	CE2. Reuse of resources within the company's production.
	CE3. Sale of resources for reuse by other companies.
	CE4. Recycling conducted by the company itself.
	CE5. Recycling conducted by others.
	CE6. Organic valorization.
	CE7. Energy valorization.
	CE8. Landfill disposal.

The questionnaire asked respondents to express their level of agreement with statements related to the implementation of circular economy and sustainable logistics practices within their companies using a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Notably, the level of agreement reflected

the extent to which the companies adopted these practices, rather than merely the perceived relevance or importance of these practices. This distinction is crucial as it directly relates to the study's objective of assessing the real-world implementation of these practices.

The survey also targeted key decision-makers and stakeholders within the participating companies directly involved in or responsible for sustainability and logistics operations. Specifically, the respondents included middle managers and production managers. These individuals were selected because of their comprehensive understanding of the company's operational practices and ability to provide informed insights into adopting circular economy and sustainable logistics practices.

4. Main Findings

4.1 Preliminary Analysis

Table 2 presents the descriptive analysis, including minimum, maximum, mean, standard deviation, skewness, and kurtosis for each item. The descriptive statistics indicate that the responses covered the full range of the scale, suggesting a reasonable diversity of responses. Additionally, a conservative approach was adopted to achieve variables with an approximately normal distribution. This approach considered skewness and kurtosis values, adhering to reference thresholds such as a skewness value less than $|3|$ and a kurtosis value less than $|8|$, as recommended by Kline (2011).

Table 2: Descriptive statistics

Latent Variable	Observed Variable	Min	Max	Mean	St. Dev	Sk.	Kurt.
Sustainable	LOG1	1	5	4.214	1.081	-2.013	4.785
	LOG2	1	5	3.929	1.163	-1.376	1.627
Logistics	LOG3	1	5	4.000	1.195	-1.411	1.536
	LOG4	1	5	4.000	1.134	-1.322	1.904
	LOG5	1	5	4.143	1.125	-1.672	3.064
	LOG6	1	5	4.143	1.125	-1.672	3.064
Circular Economy	CE1	1	5	4.643	0.610	-1.687	2.214
	CE2	1	5	4.351	0.811	-0.829	-1.017
	CE3	1	5	4.071	1.033	-0.598	-1.160
	CE4	1	5	3.857	1.125	-0.359	-1.456
	CE5	1	5	4.286	0.958	-1.218	0.521
	CE6	1	5	4.071	1.033	-0.598	-1.160
	CE7	1	5	4.357	1.172	-2.009	3.751
	CE8	1	5	3.357	1.172	-0.211	-0.474

4.2 Factor Analysis

To determine the extent to which the observed variables explained the relevant attributes (latent variables), exploratory factor analysis (EFA) was conducted using IBM SPSS Statistics 29 software. The results of the EFA are presented in Table 3. Principal component analysis (PCA), a factorial model that derives factors based on total variance, was employed. It is essential to assess the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and to conduct Bartlett's sphericity test when performing PCA. The KMO measure compares the magnitude of correlations with partial correlations; in this analysis, KMO values of 0.712 and 0.752 were obtained, indicating a moderate degree of adequacy for the PCA (Marôco, 2014). Bartlett's sphericity test confirmed that the correlation matrix was not an identity matrix, with a chi-square statistic significant at $p < 0.001$, indicating the presence of correlations among the items.

Furthermore, the diagonal of the anti-image matrix contains the measures of sample adequacy (MSA) for the observed correlations, where all variables should exhibit MSA values above 0.50 (Hair *et al.*, 1999). The results indicated that the observed variables CE6, CE7, and CE8 had MSA values below 0.50 and were consequently removed from the analysis. The communalities, representing the proportion of total variance explained by the

common factors, were above 0.50 for most variables, suggesting adequate factor extraction (Hair *et al.*, 1999). Although CE3 and CE5 demonstrated lower common variability (less than 0.50), they were retained in the analysis because their MSA values exceeded 0.50 (see Table 3). The total variance explained also met the criterion of being greater than 0.50 (Hair *et al.*, 1999).

Table 3: Factor analysis

Latent variable	Observed variable	MSA	Communalities	Total variance explained (%)	Component matrix	KMO and Bartlett's test	Cronbach's alpha (α)
Sustainable Logistics	LOG1	0.676	0.900	86.392	0.949	KMO = 0.712 Chi-square = 120.210 df = 15 sig < 0.001	0.968
	LOG2	0.598	0.743		0.862		
	LOG3	0.761	0.865		0.930		
	LOG4	0.804	0.807		0.898		
	LOG5	0.855	0.970		0.985		
	LOG6	0.627	0.898		0.948		
Circular Economy	CE1	0.880	0.748	65.172	0.865	KMO = 0.752 Chi-square = 31.301 df = 10 sig < 0.001	0.861
	CE2	0.684	0.861		0.928		
	CE3	0.626	0.443		0.665		
	CE4	0.747	0.735		0.857		
	CE5	0.897	0.472		0.687		

Following the identification of the observed variables constituting the latent variables through EFA, the next step involved conducting a confirmatory factor analysis (CFA) to evaluate the internal consistency of the constructs. The Cronbach's alpha (α) values for sustainable logistics and circular economy practices were 0.968 and 0.861, respectively, both exceeding the established threshold of 0.70 (Marôco, 2014).

4.3 Multiple Regression Analysis

A multiple regression analysis was used to predict the effect of sustainable logistics (independent variable) on the adoption of circular economy practices (dependent variable). To deal with unobserved heterogeneity, we also controlled for the effect of both supply and value chain alignment with the circular economy practices. The supply chain alignment with the circular economy was defined as the extent to which a company's supply chain activities support circular economy principles based on supplier engagement, material sourcing, and waste management practices. Likewise, the value chain alignment with circular economy refers to the arrangement of a firm's value-adding activities with circular economy objectives including product design, customer engagement, and internal processes. Respondents were asked to rate their firm's supply chain and value chain alignment using a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree").

The analysis was therefore conducted in IBM SPSS Statistics 29 software by adopting the forward method in which variables are introduced one by one. The first variable to be introduced is the one with the highest correlation coefficient with the dependent variable (Marôco, 2014). The ANOVA test displays a p-value below the significance level of 10%, suggesting that, at least, one of the predictor variables has a considerable effect on the adoption of circular economy practices (Table 4).

Table 4: ANOVA test

Model	Sum of Squares	df	Mean Square	F	Sig
Regression	6.624	3	2.208	3.463	0.059
Residual	6.376	10	0.638		
Total	13.000	13			

Predictors: (constant), sustainable logistics, value chain, supply chain

We also performed a collinearity analysis to assess its potential impact on the estimated coefficients (Table 5). Since the variance inflation factor (VIF) values are below the recommended threshold of 5 (Marôco, 2014), we

concluded that collinearity does not pose a significant issue. The results presented in Table 5 indicate that sustainable logistics has a positive and significant impact on the adoption of circular economy practices ($\beta = 0.577$; $p < 0.05$), thereby supporting our hypothesis. Additionally, we observed a positive and significant effect of value chain alignment with the circular economy on the implementation of these practices ($\beta = 0.647$; $p < 0.05$). Conversely, the alignment of the supply chain with the circular economy does not significantly affect the introduction of such initiatives ($\beta = -0.457$; $p = 0.106$).

Table 5: Model coefficients

Model	Unstandardized coefficients		Standardized coefficients	t	Sig	Collinearity Statistics	
	B	Std. Error	B			Tolerance	VIF
(Constant)	-2.079	1.243		-1.673	0.125		
Sustainable logistics	0.577	0.240	0.577	2.407	0.037	0.854	1.171
Supply chain	-0.392	0.220	-0.457	-1.777	0.106	0.741	1.350
Value chain	0.891	0.371	0.647	2.404	0.037	0.676	1.478

Dependent variable: circular economy practices

The analysis of the summary for the multiple regression analysis allows to us conclude that $Ra^2 = 0.362$, thus, approximately, 36.2% of the circular economy practices' adoption is explained by the variables included in our research model (Table 6).

Table 6: Model summary

R	R square	Adjusted R square	Std. error estimate	Durbin-Watson
0.714	0.510	0.362	0.798	2.110

Predictors: (constant), sustainable logistics, value chain, supply chain

4.3.1 Testing the Assumptions of Multiple Regression Analysis

To validate the assumptions of the multiple linear regression model, a residual analysis was conducted. Following the guidelines provided by Marôco (2014), we examined whether the residuals followed a normal distribution and were independent. The Durbin-Watson test yielded a value of 2.110 (approximately 2), indicating that the residuals are not correlated (Table 6; Marôco, 2014). Additionally, the standardized predicted and residual values exhibited approximate maximum and minimum values; however, they were not proportional (Table 7).

Table 7: Residual statistics

Model	Minimum	Maximum	Mean	Std. deviation	n
Predicted value	-1.041	1.025	0.000	0.714	14
Residual	-1.101	1.245	0.000	0.700	14
Std. predicted value	-1.459	1.435	0.000	1.000	14
Std. residual	-1.379	1.560	0.000	0.877	14

Dependent variable: circular economy practices

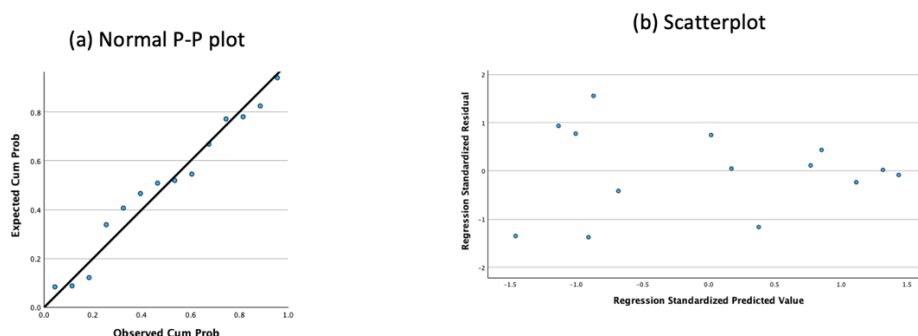


Figure 2: Residuals analysis

Additionally, the normal P-P plot of the regression standardized residual allows us to conclude that the points are relatively close to the diagonal (Figure 3a), thus the residuals follow an approximately normal distribution (Marôco, 2014). The analysis of the scatterplot corroborates this conclusion, namely by showing that the dispersion of residuals around the mean value (zero) is somehow random, with residual variances appearing to be relatively homogenous (Figure 3b; Marôco, 2014).

While the findings indicate that the research model is statistically significant and provides evidence that supports the validity of our conclusions, several limitations must be acknowledged. The low R-squared value ($R^2 = 0.362$) indicates that approximately 63.8% of the variance in the adoption of circular economy practices remains unexplained. This suggests that other relevant factors, which were not included in the model, may significantly influence the dependent variable. Additionally, the relatively small sample size ($n = 14$) may limit the generalizability of our findings. While the insights gained from this research are valuable, caution should be exercised when applying these conclusions to broader contexts.

5. Discussion

From the analysis conducted, the results showed that sustainable logistics leads to increased levels of implementation of circular economy practices in the consulted firms. The environmental impact of logistics has been the target of several types of research (e.g., Butt *et al.*, 2023; Cheng *et al.*, 2023; Zarbakhshnia *et al.*, 2023). The fact that sustainable logistics was positive and significant directly aligns the study's findings with the proposition of the natural resource-based view – NRBV (Barney, 1986). The NRBV posits that adopting sustainable practices, such as green logistics, mitigates environmental pollution and safeguards natural resources by retrieving obsolete and damaged products for remanufacturing (Cheng *et al.*, 2023). The circular economy is characterized by being restorative and regenerative, designing the process of production or service in ways that conserve natural resources (Jayarathna *et al.*, 2023).

However, the observed R-squared value of 0.362 suggests that while a significant portion of the variance in circular economy practices can be explained by sustainable logistics, a substantial amount remains unaccounted for. This observation warrants further discussion regarding the complexity of the factors driving the adoption of circular economy practices. Previous research has indicated that several antecedents can influence these practices, including organizational culture, regulatory frameworks, market pressures, and technological advancements (Genovese *et al.*, 2017; Ly, 2021). In this regard, Ly (2021) discussed the multifaceted nature of competitive advantage in circular economy models, emphasizing that contextual factors – such as industry type and geographical location – play critical roles in shaping adoption levels. This reinforces the idea that our model, while informative, is just one part of a broader landscape of influences affecting circular economy practices.

The connection between our findings and the Sustainable Development Goals (SDGs) also deserves further exploration. Specifically, our study aligns with SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action), as sustainable logistics practices can lead to more efficient resource use and reduced environmental impacts. Building on the work of Raman *et al.* (2023), we propose that enhancing green logistics not only supports the circular economy but also contributes to broader sustainability objectives by minimizing waste and promoting resource recovery. Additionally, Kumar *et al.* (2023) emphasize the challenges of adopting circular economy practices in supply chains, particularly in sectors like food where logistical efficiency is crucial. Our study reinforces these challenges, highlighting the need for a systemic approach that integrates sustainable logistics with circular economy principles to overcome barriers to implementation.

6. Conclusion

This study addressed the recent call of Burt *et al.* (2023) who emphasized the importance of establishing the missing link between logistics and its integration into circular economy practices, representing a pioneering approach to highlight the significance for academia, industry, and policymakers of promoting GL operations to advance circular economy initiatives.

Our findings have theoretical implications highlighting that forward flows should complement return flows, thereby eliminating waste from the initial product design phase and enhancing the product's recyclability. This holistic view supports closed-loop supply chain frameworks (e.g., Butt *et al.*, 2023; Zarbakhshnia *et al.*, 2023), reinforcing the cyclical flow of materials and the role of logistics in optimizing resources used and minimizing waste. This research also underpins the relevance of sustainable supply chain management by demonstrating

how logistics operations can facilitate the transition from linear to circular economy models, effecting a systemic transformation in supply chain operations to achieve SDGs.

The obtained results might also be of most relevance to decision-makers and managers who aim to introduce a circular economy business model. Enhancing sustainable logistics operations is essential for supporting circular economy principles, requiring managers to integrate GL practices – such as green transportation, eco-friendly packaging, and efficient waste management – into supply chain operations to optimize resource use and reduce environmental impact. Additionally, leveraging strategic partnerships within the supply chain, particularly with firms specializing in recycling or repurposing materials, is crucial for closing the loop in the supply chain and turning waste into valuable inputs. Implementing return flow systems, including robust reverse logistics, is also vital to ensure materials are recirculated rather than wasted. Thus, aligning corporate strategies with sustainability goals, particularly the SDGs, is necessary for companies to effectively transition to a circular economy, requiring clear sustainability objectives and regular assessments of progress.

Organizations concerned with economic, environmental, and social issues can equally influence governments to legislate robust laws compelling manufacturers to prioritize sustainable development, particularly through adopting circular economy principles and reverse logistics strategies. The circular economy aims to redefine development by emphasizing positive, comprehensive benefits rather than the current extractive industrial model characterized by the take–make–waste approach. This transformation will occur if efforts are made to decouple economic activity from the consumption of limited resources and to eliminate systemic waste. Yet, policymakers must establish and legislate policies and regulations to ensure the implementation of a circular economy. The findings of this study can assist policymakers in creating and disseminating the necessary standards and then defining the mandatory timeframes for achieving compliance targets.

Despite the abovementioned contributions, this research is not exempt from limitations. The research design's reliance on voluntary participation in the survey can introduce selection bias. Moreover, the convenience sampling, pertaining to the sample size and the characterization of Brazilian and Portuguese firms, limits the scope of our analysis. Future research should replicate this study in other countries, increasing the sample size and employing alternative sampling methods to ascertain whether the current findings are applicable in different contexts. Another limitation to be addressed is the cross-sectional research design, which cannot fully capture the evolution of GL operations and circular economy practices over time. Hence, future research should consider longitudinal data collection at multiple time intervals.

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