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REVERSE LOGISTICS AS A COMPONENT OF THE CIRCULAR ECONOMY: CHALLENGES FOR CORPORATE COMPETITIVE STRATEGIES

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Purpose: This paper explores the role of reverse logistics (RL) as a link between the circular economy (CE) and corporate competitive strategies. It outlines the evolution of RL, the CE as an alternative to the linear model, and their potential to enhance competitiveness. The empirical part draws on a 2025 survey of Polish companies to assess CE and RL adoption and their perceived impact.
Design/methodology/approach: A mixed-methods survey was conducted among 37 companies from various industries in Poland. Data were analyzed using basic statistical techniques and content analysis of open-ended responses.
Findings: Firms mostly implement low-entry CE and RL practices (e.g., waste segregation, cooperation with recycling firms), while advanced measures (e.g., design for recyclability) are rare. Reported benefits include improved reputation, cost reduction, and regulatory compliance; barriers include high investment costs, limited technology, and knowledge gaps. Overall, CE and RL have a moderate but positive impact on competitiveness.
Research limitations/implications: The purposive sample of 37 firms limits generalizability, and self-reported data may involve bias.
Practical implications: Even basic CE and RL actions can yield economic and reputational gains, guiding managers in prioritizing initiatives and addressing barriers.
Social implications: CE and RL practices can reduce environmental impacts, raise stakeholder awareness, and support sustainable development goals.
Originality/value: This study integrates CE, RL, and competitive strategy perspectives, offering empirical evidence from Polish companies and contributing to research on the strategic use of RL for competitive advantage.
Keywords: circular economy; reverse logistics; corporate competitiveness; competitive strategy; sustainable development.
Category of the paper: Research paper.

1. Introduction

In the face of escalating climate and environmental challenges, companies are increasingly seeking ways to operate more sustainably without compromising their business objectives. One of the key directions in the transformation of economic models is the circular economy (CE), which emphasizes maximizing resource use and minimizing waste. Within this context, reverse logistics (RL) is gaining prominence as a practical tool for implementing CE principles in corporate operations.

At the same time, rapid changes in competitive and regulatory environments are forcing companies to redefine the sources of their market advantage. Environmental initiatives are increasingly shifting from being merely a response to legal requirements to becoming integral components of competitive strategies – shaping customer relationships, operational costs, innovation, and corporate reputation.

The aim of this paper is to examine the role of RL as a link between CE practices and the development of competitive business strategies. It seeks to conceptually align these three domains and highlight the need for their integration in today's market conditions. The empirical section presents findings from a study of companies of various sizes and industries, exploring how they implement RL practices and how these practices influence their competitiveness.

2. Reverse logistics: evolution and contemporary relevance

Reverse logistics (RL) is a branch of logistics concerned with managing product flows after their end-of-life, primarily waste (Sadowski, 2008), but it also includes the return of functional products for repairs, recalls, and warranty claims (Huk, 2020; Szołtysek, Twaróg, 2017). Traditionally viewed as a supporting operational function, RL has evolved into a strategic component of supply chain management. It is classically defined as the process of planning, implementing, and controlling flows of products from the point of consumption back to recovery or proper disposal (Rogers, Tibben-Lembke, 1998). RL activities include returns handling, repairs, recycling, remanufacturing, component recovery, and disposal, typically divided into two domains: during-use and post-use flows (Janczewski, 2017).

Over the past two decades, RL has become embedded in closed-loop supply chains, where products are designed and managed to enable reuse or recycling after their use phase (Guide, Van Wassenhove, 2009). This integration positions RL as a key driver of reduced environmental impact and improved resource efficiency (Govindan et al., 2015).

Profitability is a recurring theme in RL research. Montabon et al. (2018) argue that RL should be treated not merely as a technical function but as a strategic tool, noting that many firms adopt compensatory actions rather than achieving true sustainability (Montabon et al., 2016). A literature review by Heydari et al. highlights that while RL operations benefit the environment and society, they often fail to generate sufficient profits for supply chain actors. Thus, regulatory mechanisms - such as incentives and fees – are considered essential to improve RL performance (Heydari et al., 2017). Effective implementation requires technological, economic, and organizational alignment, supported by collaboration across the value chain, process digitalization, and strong managerial commitment.

Recent studies emphasize the growing relevance of RL in the context of digitalization and automation (Romagnoli et al., 2023). Industry 4.0 tools – including the Internet of Things (IoT), artificial intelligence (AI), and big data analytics – enhance operational efficiency and enable real-time decision-making. These technologies support product lifecycle monitoring, returns tracking, and demand forecasting for recovered components (Krstić et al., 2022).

Contemporary approaches increasingly view RL as an integral part of product lifecycle management and a core component of circular economy models. Principles of sustainability and circularity are reshaping RL strategies, with a focus on waste reduction and resource recovery (Che Hassan, Osman, 2025). Rather than a cost factor, RL is now seen as a source of value, innovation, and customer loyalty, helping firms extend product lifecycles, close material loops, and create new value propositions.

3. The Circular Economy: a systemic approach

The concept of the circular economy (CE) emerged as a response to environmental degradation driven by unsustainable resource use and waste generation. It seeks to integrate economic activity with environmental wellbeing in a sustainable manner (Holtzer, 2022; Murray et al., 2017). The origins of CE date back to the 1940s, when ideas such as industrial symbiosis and industrial ecology were first proposed (Rada, 2023). The European Union formally introduced CE in 2015, emphasizing resource efficiency and integrated production-distribution-consumption systems (Rada, 2023). CE is closely linked to the United Nations Sustainable Development Goals, particularly Goal 12 on responsible consumption and production (Sarangi, 2023).

Scholars emphasize that CE is primarily a practical agenda for both policymaking and business, yet no single universally accepted definition exists (Jastrzębska, 2017; Kirchherr et al., 2017). The European Parliament defines CE as a "model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is

extended. In practice, it implies reducing waste to a minimum. When a product reaches the end of its life, its materials are kept within the economy wherever possible thanks to recycling. These can be productively used again and again, thereby creating further value" ("Circular economy: definition, importance and benefits", 2023). CE is also framed as a development strategy that enables economic growth while optimizing resource use, reshaping production and consumption systems, and redesigning industrial processes (Forum Odpowiedzialnego Biznesu, 2016).

At its core, CE entails a shift from a linear model (extraction–production–consumption–waste) to a circular one, in which materials and products remain in the economic cycle for as long as possible. Instead of maximizing sales and throughput, CE seeks to maximize the value derived from available resources (Dańko et al., 2021; Jaworski, Grochowska, 2017; European Parliament, 2023). This systemic approach involves designing products for repair, disassembly, reuse, and recycling, as well as developing business models based on sharing, leasing, and product-as-a-service solutions. According to Kirchherr et al., transitioning to CE requires not only technological change but also shifts in mindsets, organizational structures, and cross-sector collaboration. CE has become a policy priority for the European Union.

Implementation strategies for CE include reducing resource extraction, promoting regenerative production, and ensuring effective end-of-life management (Sarangi, 2023). However, CE has limitations – most notably the lack of explicit social dimensions inherent in broader sustainable development frameworks (Murray et al., 2017). Despite these challenges, CE remains a promising approach to addressing global sustainability issues. In April 2022, the European Commission proposed a policy package to accelerate the EU's transition to CE. Yet, as Pinyol Alberich, Pansera, and Hartley (2023) argue, these policies are built on a hybrid mix of often competing visions of a circular future. Dominant narratives reflect a techno-optimistic and centralized "modernist" vision of CE, which may result in a weak version unable to meet the EU's environmental ambitions.

Within this context, reverse logistics (RL) becomes a critical operational component that enables material recovery and reverse flows within supply chains. RL facilitates the handling of returns, sorting, recovery, and transport to repair or processing facilities, requiring robust informational, technological, and organizational infrastructure. Emerging models such as the sharing economy, biological resource regeneration, urban mining, and circular platforms depend on advanced logistics systems capable of managing goods within closed loops. Effective CE implementation requires aligning environmental and economic objectives, making CE both a challenge and an opportunity for innovative firms (Aguirre Rodríguez et al., 2024).

4. Competitive strategy: classical and contemporary perspectives

A competitive strategy is a long-term plan that guides a firm's efforts to gain and sustain an advantage over its market rivals. It defines how the firm competes, what differentiates its offerings, and which resources and actions will be deployed to attract customers and achieve superior performance. The concept of competitive advantage itself has no single, universally accepted definition. According to Malewska and Sajdak (2014), it can be understood as a situation in which a firm possesses something others do not, does something better than its rivals, or performs activities competitors cannot, thereby generating superior outcomes. A widely adopted perspective is that of Michael E. Porter, who defines competitive advantage as the ability to perform activities better or differently than competitors, leading to superior results (Porter, 2010).

In management literature, strategy is generally viewed as a means of achieving a firm's core objectives as defined in its mission. It provides a framework for market activity, guiding operational and strategic decisions (Kaczmarek-Kalisz, Guliński, 2010). A competitive strategy enables organizations to direct their development, concentrate and allocate resources effectively, and make coherent operational and investment decisions. According to Porter's classical framework, sustainable competitive advantage can be pursued through cost leadership, differentiation, or market focus (Porter, 2010). Traditional sources of competitiveness also include cost, distribution, marketing, technology, market position, product uniqueness, managerial quality, knowledge, information, and time-based management (Kożak-Siara, Olak, 2022).

However, contemporary sources of competitive advantage increasingly extend beyond Porter's classical model and reflect the dynamics of global markets, technological development, and evolving customer expectations. Today, firms compete not only on price and product but also on innovation, relationships, speed, agility, sustainability, and knowledge (Kożak-Siara, Olak, 2022; Zakrzewska-Bielawska, Piotrowska, 2022).

5. Reverse logistics as a link between the Circular Economy and competitive strategy

Research on reverse logistics (RL) and the circular economy (CE), in connection with corporate competitive strategy, shows that both concepts can enhance how firms are perceived by customers, thereby strengthening their competitiveness. Increasingly, companies build competitive advantage on their ability to adopt circular models, manage product life cycles, reduce carbon footprints, and ensure supply chain transparency. The capability to recover

and reuse products is becoming not only a sign of responsibility but also a strategic market lever. In this context, RL serves as a tool for implementing sustainable strategies and building innovation- and relationship-based advantages (Gao, 2018; Ivanova et al., 2022; Voigt et al., 2019).

Similar links are observed between competitive advantage and CE. CE is gaining traction in both academic and business discourse as an alternative to the dominant linear "take–make–dispose" model (Pichlak, 2018). Unlike the linear model, CE aims to extend the life cycle of products and materials, reduce the consumption of virgin resources, and regenerate natural systems (Szczech-Pietkiewicz, Czerniak, 2024). Its implementation can strengthen firms' competitive positions by improving resource efficiency, reducing operating costs, fostering innovation, and enhancing stakeholder reputation (Kwiecień, Wawrowski, 2019; Zupok, 2021). CE principles also support competitiveness through product and process innovation, supply chain optimization, and new business models such as product-as-a-service or closed-loop material systems (Kwiecień, 2018, 2021). Firms adopting such solutions often gain better access to new markets and customers and improve their relationships with business partners (Zupok, 2021). CE is further seen as a way to mitigate risks related to rising resource prices, regulatory changes, and environmental pressures (Kwiecień, 2018).

However, empirical studies show that many Polish firms do not yet view CE as a genuine source of competitive advantage. Many apply only selected elements—such as waste segregation and recycling—without integrating circular principles across the entire value chain (Kachniewska, 2018; Szczech-Pietkiewicz, Czerniak, 2024). Reported barriers include high upfront costs, lack of short-term returns, limited financing, insufficient institutional support, and low awareness among managers and consumers (Kachniewska, 2018; Kwiecień, 2018; Szczech-Pietkiewicz, Czerniak, 2024).

Approaches to CE implementation vary by industry and firm size. In manufacturing, efforts focus on eco-design, process optimization to minimize material losses, and closing resource loops through recycling and component reuse (Kwiecień, 2018). In services, such as hospitality, opportunities are more limited due to complex supplier networks, subcontracting relationships, and less flexibility in material and technology choices (Kachniewska, 2018). From an economic perspective, CE can be profitable in the long term through resource and energy savings and improved corporate reputation (Kwiecień, 2018). Nevertheless, high initial investment thresholds and uncertainty about payback periods remain major obstacles. The literature thus reveals a clear gap between the declared benefits and the actual level of implementation – indicating that the competitive potential of CE in Polish enterprises remains largely untapped (Kwiecień, 2021).

Contemporary management approaches increasingly call for viewing RL not as an isolated function but as a critical link between the operational implementation of CE and a firm's strategic objectives. Concepts such as closed-loop supply chains and circular value creation underscore RL's role in fostering organizational flexibility, resilience, and innovation.

Effective integration of CE, RL, and corporate strategy requires not only operational transformation but also a rethinking of business models and strategic orientations. This highlights the need for in-depth empirical studies to explore how firms actually implement RL practices, how they evaluate them, and what barriers and opportunities they face in linking these practices to market competitiveness and circularity.

While both circular economy (CE) and reverse logistics (RL) have been widely studied, most existing research treats them as separate operational or environmental practices rather than as interconnected elements of competitive business strategies. Prior studies typically focus on technical, environmental, or cost aspects of RL and CE, offering limited insight into their strategic integration and their combined impact on firm competitiveness. Moreover, empirical evidence remains scarce – particularly cross-sectoral studies at the firm level – that would reveal how companies actually adopt CE and RL practices, how they assess their effects, and what barriers they face in linking these practices to long-term competitive advantage.

This paper seeks to address this gap by conceptually framing CE and RL within a competitiveness-oriented perspective and by providing empirical evidence from diverse Polish enterprises. The study contributes by examining not only the extent of CE and RL implementation, but also their perceived strategic value, offering a multidimensional view of how operational practices can support competitive positioning and business model transformation.

6. Methods

The study employed a mixed-methods design and was conducted using a standardized questionnaire survey targeting companies operating in Poland. Its aim was to identify the scope of reverse logistics (RL) and circular economy (CE) implementation and to assess their perceived impact on firms' competitiveness.

The questionnaire was structured into several thematic sections:

- section B – CE practices and activities (8 items, 5-point Likert scale),
- section C – RL practices (14 items, 5-point scale),
- section D – perceived impact of RL and CE on competitiveness (7 items, 5-point scale),
- section E – barriers to RL and CE implementation (8 items, 5-point scale),
- section F – quantitative performance data (e.g., recovery costs, share of recycled materials; optional),
- section G – development plans in RL and CE (5 items, 5-point scale),
- section H – open-ended questions for qualitative insights (11 questions).

Closed-ended questions used a five-point Likert scale (1 = "strongly disagree", 5 = "strongly agree"). The open-ended questions collected examples of good practices, key barriers, and proposals for measures supporting RL and CE development in Polish enterprises.

Data were analyzed using descriptive statistics (means, medians, standard deviations) and preliminary dependency tests. Qualitative responses were thematically coded into recurring categories (e.g., technical barriers, legal barriers, cost-related benefits, reputational effects).

The study covered 37 companies from various industries:

- manufacturing – 29.7% (n = 11),
- transport and logistics – 27.0% (n = 10),
- waste/recycling – 21.6% (n = 8),
- services – 16.2% (n = 6),
- trade – 5.4% (n = 2).

In terms of size, the sample consisted of small and medium-sized enterprises. The sample was purposively selected to ensure sectoral diversity and varying levels of RL and CE implementation. Not all invited companies agreed to participate, so the analysis included only those that consented. Participation was voluntary, and responses were anonymous. Some questions, mainly those concerning economic data, allowed non-responses to reflect practical limitations in accessing sensitive business information. Given the small and purposive nature of the sample and the exploratory scope of the research, the study should be regarded as preliminary. Its results offer indicative insights into the relationship between reverse logistics, the circular economy, and competitiveness, but they do not allow for broad generalizations.

6. Results

6.1. Results of the quantitative analysis

The quantitative analysis was conducted using three composite indexes: I_CE, reflecting the level of circular economy implementation; I_RL, indicating the degree of reverse logistics implementation; and I_COMP, measuring the respondents' subjective assessment of the impact of CE and RL activities on their company's competitiveness.

Index values were calculated from the mean scores in the relevant questionnaire sections and rescaled to a 0-100 range. The table 1. presents the means, medians, and standard deviations for each index, both by industry sector and for the total sample.

Tabele 1.
Synthetic Indexes of CE, RL and Competitiveness: Descriptive Results by Sector

Sector	I_CE_Mean	I_CE_Median	I_CE_SD	I_RL_Mean	I_RL_Median	I_RL_SD	I_COMP_Mean	I_COMP_Median	I_COMP_SD
Trade	48.4	48.4	11.0	44.6	44.6	7.6	53.6	53.6	15.2
Waste/Recycling	57.4	57.8	10.7	63.2	61.6	7.0	60.7	64.3	9.2
Manufacturing	54.3	56.2	10.3	53.2	51.8	7.5	56.5	60.7	14.0
Transport/Logistics	52.2	53.1	9.8	54.6	54.5	7.3	50.4	50.0	15.9
Services	41.7	43.8	10.4	48.2	50.9	7.9	50.0	48.2	7.8
Overall	52.0	53.1	11.0	54.5	53.6	8.8	54.5	53.6	12.9

Source: own elaboration based on survey results.

The results indicate that the overall levels of circular economy (I_CE) and reverse logistics (I_RL) implementation in the surveyed companies are moderate, and their perceived impact on competitiveness (I_COMP) is at a similar level. The highest index values were observed in the waste and recycling sector (I_CE = 57.4; I_RL = 63.2; I_COMP = 60.7), confirming that the nature of this sector facilitates the adoption of CE and RL solutions, which are closely integrated into its business models and competitive positioning.

High I_CE scores were also recorded in manufacturing (54.3), accompanied by a relatively strong competitiveness rating (56.5), suggesting that CE implementation can bring tangible benefits in production processes. In the transport and logistics sector, the three indexes are close to the sample average, which may reflect partial adoption but also indicate substantial growth potential, particularly in linking RL practices more directly to market advantage.

The trade sector shows lower I_CE (48.4) and I_RL (44.6) scores, likely due to fewer return and recovery processes compared with manufacturing and processing. The lowest values of I_CE (41.7) and I_RL (48.2) were recorded in services, where opportunities to implement closed-loop material processes are limited by the intangible nature of the activities provided.

Overall, the analysis reveals a clear relationship between sector-specific characteristics and the level of circular economy (I_CE) and reverse logistics (I_RL) implementation, as well as their perceived impact on competitiveness (I_COMP). In sectors where CE and RL are embedded in the business model, the index values are higher and align more closely with competitiveness assessments. By contrast, sectors with lower material intensity show considerable potential for further development in this area.

To gain a deeper understanding of the nature of the initiatives undertaken by the surveyed companies, the most commonly implemented CE and RL practices were also analyzed. The table 2. below summarizes these practices, including the number and percentage of firms applying them.

Tabele 2.
Overview of Common CE and RL Practices Implemented by Enterprises

Practice	Area	Number of enterprises	% of enterprises
Waste segregation at the source	CE	33	89.2
Recovery of secondary materials in production processes	CE	24	64.9
Product design for recycling	CE	17	45.9
Waste minimization through process optimization	CE	22	59.5
Customer return and take-back systems	RL	19	51.4
Cooperation with recycling companies	RL	26	70.3
Monitoring and analysis of return causes	RL	21	56.8
Use of recovered materials in new products	CE/RL	20	54.1
Reuse of packaging	CE/RL	25	67.6
Incentive programs for customers to return products	RL	15	40.5

Source: own elaboration based on survey results.

As shown in the table, the most common practice is waste segregation at the source, implemented by 89.2% of the surveyed enterprises. A substantial share of firms also report cooperating with recycling companies (70.3%) and reusing packaging (67.6%). Practices directly linked to reverse logistics – such as customer return and take-back systems (51.4%) and the monitoring and analysis of return causes (56.8%)—are also widely adopted.

In contrast, practices requiring greater investment or design changes, such as designing products for recyclability (45.9%) or offering customer incentives for product returns (40.5%), are less common. These results suggest that firms tend to prioritize practices that are relatively easy to organize, while initiatives requiring fundamental business model changes are adopted less frequently.

6.2. Results of the qualitative analysis

Section H of the questionnaire contained open-ended questions designed to complement the quantitative results by exploring the perceived benefits, barriers, and suggested measures for further developing circular economy (CE) and reverse logistics (RL) practices. The aggregated results are presented in Table 3.

Responses from 37 companies show that the most frequently reported benefit was improved corporate image and customer relationships (68%). Many respondents emphasized that CE- and RL-related activities enhance company reputation and credibility in the market. The second most common benefit was reduced operating costs achieved through the reuse of materials and packaging (54%). Some firms (41%) indicated improved compliance with legal regulations and avoidance of potential sanctions, while a smaller share (27%) mentioned the development of innovative products and services.

The most frequently cited barrier was the high investment cost associated with new technologies and process upgrades (62%). Lack of access to suitable technological solutions was reported by 49% of respondents, and insufficient knowledge and competencies in CE and RL by 46%. Additionally, 24% highlighted difficulties in integrating new practices with existing logistics processes and the lack of business partners willing to cooperate in this area.

As for recommendations, respondents most often suggested expanding financial support programs for CE and RL investments (59%) and offering training and educational campaigns for managers and employees (51%). Furthermore, 38% called for the creation of inter-company collaboration platforms to exchange resources, materials, and information. A smaller share (19%) pointed to the need for stronger regulatory pressure to accelerate CE and RL adoption at the economy-wide level. The results are summarised in Table 3.

Tabele 3.
Benefits, barriers, and recommendations for implementing CE and RL in the surveyed firms

Category	Description	% of firms
Improved corporate image and customer relationships	Perceived as strengthening the firm's reputation and credibility	68%
Reduced operating costs	Savings through the reuse of materials and packaging	54%
Regulatory compliance	Avoiding sanctions and aligning with legal requirements	41%
Innovation development	Creating new products and services	27%
High investment costs	Expenditures on technologies and process upgrades	62%
Lack of technologies	Limited access to appropriate technological solutions	49%
Lack of knowledge and competencies	Shortage of CE and RL-related skills	46%
Integration challenges	Difficulties aligning new practices with existing processes	24%
Lack of business partners	Insufficient collaboration within the supply chain	24%
Financial support	Need for subsidies and tax incentives	59%
Training and education	Raising awareness and developing managerial and employee competencies	51%
Collaboration platforms	Sharing resources, materials, and information	38%
Regulatory pressure	Strengthening legal requirements to accelerate adoption	19%

Source: own elaboration based on survey results.

These findings highlight the dual nature of CE and RL adoption: while firms recognize clear reputational and cost-related benefits, they also face substantial financial, technological, and knowledge-related barriers. This contrast sets the stage for a broader discussion of how these practices can be more effectively integrated into competitive strategies.

7. Discussion

This study, combining both quantitative and qualitative analyses, offers insights into the complex relationships between the circular economy (CE), reverse logistics (RL), and firms' competitiveness. The quantitative findings show a generally moderate level of implementation in both areas, with notable differences across sectors. Industries characterized by high material intensity, such as manufacturing and waste/recycling, achieved the highest I_CE and I_RL scores, alongside relatively strong assessments of their impact on competitiveness (I_COMP). This suggests that circular practices and reverse flows are more easily embedded in the core business models of these sectors, directly contributing to operational efficiency and competitive

positioning. By contrast, service-oriented firms reported the lowest index values, reflecting the limited opportunities to introduce closed-loop material flows in less material-intensive contexts.

The qualitative results enrich this picture by revealing managerial and practitioner perspectives. The most frequently cited benefit of CE and RL adoption was improved corporate image and customer relationships, indicating an indirect competitive effect rooted in intangible factors. Reduced operating costs and enhanced regulatory compliance were also highlighted as key advantages, while innovation was mentioned less often and primarily by companies more advanced in circular implementation. At the same time, persistent barriers – particularly high investment costs, limited access to modern technologies, and a lack of knowledge and competencies – constrain the scale of adoption. These challenges help explain why more demanding initiatives, such as designing products for recyclability or implementing customer return systems, are still relatively rare.

The findings are also consistent with observations presented in international research on CE and RL adoption. Rogers and Tibben-Lembke (1998) as well as Guide and Van Wassenhove (2009) emphasize that reverse logistics activities are frequently implemented at a basic operational level, while their integration into strategic business processes remains limited – a tendency that is likewise visible in the analysed sample. Govindan et al. (2015) and Heydari et al. (2017) identify economic and technological barriers as key obstacles to the effective functioning of reverse flows, which corresponds to the reported challenges, particularly high investment costs and insufficient technological capabilities.

The results also reflect conclusions reached by Voigt et al. (2019) and Ivanova et al. (2022), who argue that the main competitive benefits associated with CE and RL – such as enhanced corporate image, improved stakeholder relationships, and regulatory compliance – tend to be indirect and long-term rather than immediate. At the same time, while research by Romagnoli et al. (2023) and Krstić et al. (2022) points to the growing application of digital technologies (IoT, AI, big data) in supporting reverse flows, such solutions remain relatively uncommon among Polish enterprises. Similarly, in contrast to findings from Pinyol Alberich et al. (2023), where strong institutional support significantly accelerates CE adoption in Scandinavian countries, companies operating in Poland face a less favourable policy and market environment. These contrasts highlight the decisive role of contextual factors – including regulatory frameworks, technology maturity, and institutional incentives – in shaping the pace and scale of CE and RL implementation.

Taken together, the findings suggest that the effective integration of CE and RL requires coordinated efforts across four dimensions: technological (investments in innovation and infrastructure), organizational (embedding circular processes into business models), educational (building managerial and employee awareness and competencies), and institutional (developing stable regulatory frameworks, financial incentives, and collaboration platforms). Importantly, the competitive advantages associated with CE and RL are no longer primarily cost-based. They increasingly derive from reputational, relational, and innovation-oriented

factors that enhance stakeholder trust and strengthen firms' long-term resilience in sustainability-driven markets.

Overall, the study confirms that many Polish firms continue to perceive CE and RL mainly as sets of operational practices, even though their strategic potential is becoming more widely recognized. Unlocking this potential will require comprehensive business model transformation supported by an enabling institutional environment.

8. Conclusions

The study on the implementation of the circular economy (CE) and reverse logistics (RL) in Polish enterprises provides a multidimensional picture of the practices adopted across different sectors and their perceived impact on competitiveness. The quantitative analysis revealed that companies tend to implement practices that are organizationally and technically simple, such as waste segregation, cooperation with recycling firms, and packaging reuse. These measures are attractive due to their low entry barriers, relatively quick cost effects, and regulatory compliance. In contrast, more advanced practices, such as designing products for recyclability or establishing customer return systems, are implemented far less frequently, primarily due to financial, technological, and organizational barriers.

The qualitative part of the study helped identify both key benefits (enhanced reputation and customer relationships, cost reduction, regulatory compliance) and major constraints (high investment costs, lack of suitable technologies, insufficient knowledge and competencies, integration challenges). These findings suggest that while companies recognize the strategic potential of CE and RL, they currently implement mostly operational-level activities, postponing full transformation to later stages of development.

Several key insights emerge from this research. First, the adoption of CE and RL can have a tangible impact on competitiveness, largely through indirect effects, such as reputation, customer relationships, and compliance, that may evolve into lasting market advantages over time. Second, there is a clear relationship between sectoral characteristics and the degree of implementation, indicating that support strategies and policy tools should be tailored to the diverse needs of different industries. Third, the effective integration of CE and RL into corporate strategies requires coordinated efforts across multiple dimensions: technological, organizational, educational, and institutional.

In sum, the implementation of CE and RL practices can significantly enhance firms' competitiveness, but their full potential in Poland remains largely untapped. Further progress will require both strategic commitment from companies and consistent institutional support

to reduce implementation barriers and create favorable conditions for a broader transition toward a circular economy.

The results of the study also provide several important theoretical and practical implications. From a theoretical perspective, the findings confirm observations made in the international literature that reverse logistics and circular economy practices tend to generate competitive benefits primarily through indirect, long-term effects, such as improved corporate reputation, stakeholder relations, and regulatory compliance, rather than immediate cost reductions. The research additionally indicates that contextual factors – including regulatory frameworks, technological maturity, and institutional support — significantly shape the scale and pace of CE and RL implementation, which helps explain differences between Polish enterprises and firms operating in more advanced economic environments.

From a practical standpoint, the study highlights the necessity of integrating circular processes into strategic business planning rather than limiting them to isolated operational activities. This requires coordinated actions in technological, organizational, educational, and institutional areas, as well as targeted public policies and financial instruments to support corporate transformation. These insights may serve as a reference point for both companies seeking to strengthen their competitive position and policymakers designing instruments to accelerate the transition toward a circular economy. Furthermore, the results underline the need for future research exploring sector-specific pathways and the role of emerging technologies in enhancing the strategic potential of CE and RL.

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