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Reverse logistics and financial performance in a developing country context: the moderating role of analytics capability

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Abstract

Purpose – This paper aims to examine the financial outcome of reverse logistics among firms in a developing country. The authors draw on the organizational information processing theory to propose that analytics capability moderates the relationship between reverse logistics and financial performance.

Design/methodology/approach – The authors collected firm-level survey data from 200 manufacturing firms in Ghana, a developing country in sub-Saharan Africa. Partial least squares structural equations modeling is used to examine the proposed relationships, and the moderating effects are further probed using Hayes PROCESS.

Findings – The empirical results show that reverse logistics is negatively related to financial performance. However, analytics capability attenuates this negative relationship, such that firms with high analytics capability obtain a positive relationship between reverse logistics and financial performance.

Practical implications – Firms in developing countries should combine their reverse logistics strategies with developing analytics capabilities that help minimize uncertainties and increase the efficient collection and use of information to reduce the cost of reverse logistics.

Originality/value – This paper examines how reverse logistics relates to financial performance in low-resource contexts. Beyond the novelty of the context, it explores the information processing needs of reverse logistics systems and provides empirical data to support analytics capability. This has yet to be considered in prior studies.

Keywords Reverse logistics, Environmental sustainability, Analytics capability, Organizational information processing theory, Developing country, Ghana, Circular economy

Paper type Research paper

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1. Introduction

The exponential growth in consumerism, shortening product life cycles and linear (take-make-dispose) rather than circular (take-make-reuse) economy approaches have led to severe environmental management problems: pollution, natural resource exhaustion, greenhouse gas emissions, etc. (Appiah and Odartey, 2021; Kumar *et al.*, 2023; Mugoni *et al.*, 2023; Siew *et al.*, 2016). This has increased stakeholder attention toward reverse logistics – the backward movement of products from downstream sources to upstream sources in the supply chain (Hazen *et al.*, 2015) – for reusing, recycling, remanufacturing or safe disposal (Sarkis *et al.*, 2010; Wu, 2022). Extant research considers reverse logistics an integral part of the green supply chain management strategy (Liu *et al.*, 2020; Uygun and Dede, 2016) that helps to "close the loop" created by products at the end of their lifecycle (Panigrahi *et al.*, 2019).

While reverse logistics contributes favorably to environmental sustainability, only a few sustainability initiatives survive as cost centers (Morgan *et al.*, 2018). Many companies conventionally perceive reverse logistics as a "necessary evil" rather than recognizing its potential to improve business performance, resulting in the widespread neglect of its impact despite the accepted view that it can generate cost savings and enhance financial performance (Fernando and Abideen, 2021; Huang and Yang, 2014). Therefore, an important question, which is still debated, is whether reverse logistics enhances or instead hurts corporate financial performance (Lai *et al.*, 2013; Li *et al.*, 2023). One side of the argument, supported by the natural resource-based view, suggests that reverse logistics can enhance the profitability of companies by enabling the resale or reuse of returned products and reducing disposal costs (Hart, 1995; Škapa and Klapalová, 2012). On the other hand, inefficient return processes may result in high operational costs, resale of returned items may not always be feasible and poorly managed reverse logistics can increase processing times and excess inventory, tying up resources and negatively impacting cash flow (Li *et al.*, 2023). Given the double-sided nature of reverse logistics outcomes, two critical questions are (1) What is the impact of reverse logistics on a firm's financial performance and (2) When does it pay to invest in reverse logistics?

Although several studies have investigated different aspects of reverse in various research settings, very few studies have focused on measuring the performance outcomes of reverse logistics implementation (Kumar *et al.*, 2023; Prajapati *et al.*, 2021). The majority of studies have instead focused on developing models based on a balanced scorecard perspective, meta-heuristics and intelligent algorithms (Prajapati *et al.*, 2021) to theoretically model reverse logistics systems. Only a few studies have empirically examined the impact of reverse logistics on organizational outcomes, such as environmental performance (Kalubanga and Mbekeka, 2023), digitalization (Rasool *et al.*, 2023) and financial/economic performance (Li *et al.*, 2023; Morais *et al.*, 2018). Consequently, there are several calls for research that sheds light on the consequences of reverse logistics practices on a firm's bottom line (Kalubanga and Mbekeka, 2023; Pushpamali *et al.*, 2021).

Three main research gaps exist in this research stream. First, the results of empirical studies that examine the relationship between reverse logistics and financial performance are largely equivocal, suggesting the need for research into the factors that condition the relationship (Banihashemi *et al.*, 2019; Rasool *et al.*, 2023; Vlachos, 2016). While some studies found that reverse logistics positively affects financial performance (e.g. Lai *et al.*, 2013; Morais *et al.*, 2018; Prajapati *et al.*, 2021), others found no such financial benefits (e.g. Li *et al.*, 2023; Škapa and Klapalová, 2012). Although theoretically considered profitable, some studies suggest there is a high tendency for reverse logistics systems to be unprofitable (Kumar *et al.*, 2023). Second, this research stream is dominated by case studies providing evidence from a single organization's viewpoint, with only a few studies (such as Kalubanga and Mbekeka, 2023; Rasool *et al.*, 2023) conducting large-scale surveys that provide generalizable results. Third, this stream of research is dominated by studies from developed and emerging economies, with very little attention paid to developing economies that have just begun their sustainability journey (Govindan and Bouzon, 2018). This constrains the global applicability of the existing theories supporting reverse logistics systems and how they impact financial performance.

This paper seeks to address the research gaps outlined by examining the three limiting aspects of previous research:

(1) The need for contingent variables;

(2) Alternative research methodology; and

(3) The need to expand the research into new contexts.

First, the inconsistency in empirical findings on the relationship between reverse logistics and financial performance points to boundary conditions requiring research attention. Reverse logistics requires synchronization of product movement, seamless information flow and high levels of traceability in the supply chain (Agrawal *et al.*, 2015). Therefore, this study draws on the organizational information processing theory (OIPT) to argue that the firm's analytics capability – the ability to process vast volumes of data efficiently – (Zhu *et al.*, 2018) conditions the relationship between reverse logistics and financial performance. Second, this paper deviates from the dominant case study methodology used in previous studies to conduct a large-scale survey that increases the ability to generalize the results and also provides an overview of the financial outcome of reverse logistics among firms in the research context. Third, the operational requirements for reverse logistics are higher for firms in developing countries that operate in less formalized economies with low supply chain integration and poor data processing systems (Appiah, 2024). Therefore, reverse logistics increases firms' information processing requirements in these contexts, suggesting that financial benefits can only be obtained when firms develop the capability to acquire, process and interpret vast amounts of data quickly. This research enhances scholarly understanding of how firms benefit from reverse logistics implementation in a developing country context.

The remainder of this paper is structured as follows: first, a review of reverse logistics and how it has been conceptualized in recent research. Then, a thorough review of research on the performance outcomes of reverse logistics and the concept of analytics capability follows. The next section reviews the OIPT and follows it with the hypothesis. This is followed by a detailed discussion of the research methodology and data analysis. The discussions and implications of the research are then presented, and finally, the conclusions and limitations of the study are presented.

2. Literature review

2.1 Reverse logistics: definition and conceptualization

Reverse logistics, previously viewed as the process of recycling used/malfunctioned products, has expanded to include processes connected with product return and collection for recovery, repair, refurbishment, recycling, remanufacturing or disposal of used/end-of-life items (Rasool *et al.*, 2023). The current focus on reverse logistics is not just moving products backward but doing so to capture value (Wilson *et al.*, 2022). While there are several definitions of the term, the main focus of these definitions has been on the direction of movement and the purpose of the movement. For instance, Rogers and Lembke (2021) define reverse logistics as:

> The process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin to recapture value or proper disposal.

Reverse logistics is also described as “the effective and efficient management of the series of activities required to retrieve a product from a customer in order to either dispose it or recover value,” with activities including transferring used products from the customers’ possession to the recovery site also being termed “take-back” (Kumar *et al.*, 2023). In the manufacturing context, it is defined as the process by which a manufacturer systematically takes back previously shipped products or parts from the point of consumption for possible recycling, remanufacturing or disposal. Reverse logistics helps extend the life of materials and products, reducing environmental burdens from industrial operations (Lai *et al.*, 2013). Thus, reverse logistics describes the transportation, warehousing and inventory management activities involved with the reverse supply chain process whereby efforts are made to recover value from any product or material that a customer returns to a supply chain network (Ye *et al.*, 2013).

Reverse logistics has been studied as either a standalone process (e.g. Hazen *et al.*, 2015; Hsu *et al.*, 2016; Ramírez, 2012; Vlachos, 2016), as part of the green supply chain management construct (Islam *et al.*, 2017; Liu *et al.*, 2020; Uygun and Dede, 2016) or in circular (closed loop) economy studies (Fernando and Abideen, 2021; Kumar *et al.*, 2023). Studies on green supply chain management are incomplete without considering how companies “close the loop” because it helps decrease waste produced by processing and disposing of returned and used goods by implementing a variety of disposition alternatives (Rasool *et al.*, 2023). Reverse logistics can be described from an environmental management perspective as a management approach whereby adopting companies can become more environmentally efficient through recycling, reusing and reducing the amount of materials used. Resultantly, reverse logistics procedures differ depending on the underlying rationale for the product returns (Rogers and Lembke, 2021). Reverse logistics activities take different forms – defective items, surplus inventory, seasonal merchandise, materials for recycling, obsolete stock and potentially hazardous materials returned for proper disposal (Banihashemi *et al.*, 2019).

Reverse logistics has been conceptualized separately in different studies across the literature. The primary reverse logistics dispositions include remanufacturing, recycling, reusing, refurbishing, repackaging, reprocessing, material recovery and waste treatment (Kalubanga and Mbekeka, 2023). Some studies consider reverse logistics to be a single construct, e.g. (Asamoah *et al.*, 2023; Kalubanga and Mbekeka, 2023), while others disaggregate the concept into dimensions such as product returns (Fernando and Abideen, 2021; Ye *et al.*, 2013), product recovery (Siew *et al.*, 2016) and product recycling (Fernando and Abideen, 2021). The common theme in these studies, however, is that the outcomes of the reverse logistics processes include refurbishment, component repurposing, warehousing, recycling, disposal and specialized treatment.

2.2 Performance outcome of reverse logistics

Given the prevalence of reverse logistics, several studies have examined its performance outcomes. Performance evaluation is necessary for managers to know the efficiency and effectiveness of their actions and avoid unnecessary expenses and losses (Hammes *et al.*, 2020).

Studies have reported many benefits of successful reverse logistics activities, such as higher profits, increased customer satisfaction and loyalty, cost reduction and better environmental performance (Rasool *et al.*, 2023). By design, reverse logistics may benefit environmental sustainability through "returns to resell, refurbish, recondition, remanufacture, cannibalize for parts, or recycle products to minimize landfill waste"(Morgan *et al.*, 2018). Reverse logistics also provides economic benefits in less raw material procurement, inventory control and landfill by setting strategic locations for collection centers, reprocessing centers, remanufacturing and transportation (Fernando and Abideen, 2021). Effective reverse logistics increases customer satisfaction and saves costs (Rasool *et al.*, 2023; Vlachos, 2016). Reverse logistics also enhance financial performance by reducing material and energy consumption (Ye *et al.*, 2013), generating additional value from recycled products that would otherwise be discarded (Srivastava, 2007) and improving a firm's green image to increase customer patronage (Hsu *et al.*, 2016).

Reverse logistics can differentiate a firm, leading to market and competitive advantages (Hsu *et al.*, 2016). Firms can sell recovered and/or returned products in secondary markets to generate revenue. Reverse logistics systems could also enhance customer loyalty because environmentally conscious customers will generate goodwill for the firm and increase its competitiveness (Hsu *et al.*, 2008). Redesigning logistics networks to accommodate product returns and remanufacturing and reusing such parts and components can often be profitable (Srivastava, 2007). By demonstrating their commitment to delivering on their warranty promise, firms can obtain greater profitability and customer satisfaction and benefit the environment (Huang and Yang, 2014). Many studies have reported many benefits of successful reverse logistics activities, such as higher profits, increased customer satisfaction and loyalty, cost reduction and better environmental performance (Rasool *et al.*, 2023).

However, reverse logistics systems are also complex, often more expensive and differ significantly from forward logistics (Ramírez, 2012). Reverse logistics requires the deployment of resources, and there is often a potential risk that these investments will not pay back (Das and Hall, 2020; Kumar *et al.*, 2023). Therefore, reverse logistics does not always guarantee financial performance (Banihashemi *et al.*, 2019). There is often a chance that reverse logistics increases operations costs and fails to repay its investment (Ye *et al.*, 2013).

As Table 1 presents, previous research has examined several reverse logistics implementation performance outcomes. The financial/economic performance dimension is the most popular, as researchers and managers seek to answer whether reverse logistics can be financially beneficial. Other studies, particularly those that view reverse logistics from the sustainability viewpoint, have often examined how the practice relates to the triple bottom line (environmental, social and economic) outcomes concurrently. The results have been largely positive, but some studies suggest that reverse logistics could have undesirable benefits, such as "significantly adding to costs" and increasing the supply chain's carbon footprint due to the increased transport intensity of reverse logistics operations (Li *et al.*, 2023). Others found that while some aspects of reverse logistics can enhance performance, some aspects do not impact performance (Siew *et al.*, 2016). Studies that use multiple performance indicators have also shown that reverse logistics can affect some indicators and not others. Only a few studies have examined mechanisms and boundary conditions in reverse logistics and organizational outcomes.

2.3 Analytics capability

Adopting reverse logistics is a complex process and often requires firms to undergo substantial changes and overcome multiple internal and external barriers. To overcome

Table 1. Indicative studies on the performance outcome of reverse logistics implementation

Author	Outcome	Moderator/mediator	Theory	Context/methods	Findings
Asamoah *et al.* (2023)	Environmental performance, green firm reputation	Environmental performance	Resource-based view	Beverage manufacturers in Ghana/survey	Reverse logistics enhances environmental performance, enhancing green firms' reputations
Kalubanga and Mbekeka (2023)	Environmental performance		Stakeholder theory	Food and beverage manufacturers in Uganda/ survey	Reverse logistics is positively related to corporate environmental performance
Li *et al.* (2023)	Financial costs; environmental impacts			Two municipal waste sites in X'tian, China/case study	Reverse logistics significantly adds to costs and has negative environmental impacts
Rasool *et al.* (2023)	Digitalization and interorganizational collaboration			Longitudinal survey data from Mainhem center for Europen research	Reverse logistics enables digitalization and interorganizational collaboration
Kazancoglu *et al.* (2021)	Green performance			Single production plant in Kenyan/case study	Reverse logistics significantly contributes to green performance
Prajapati *et al.* (2021)	Multiple indicators			India electrical manufacturing/case study	Reverse logistics helps to improve financial performance
Fernando and Abideen (2021)	Financial performance		Natural resource-based view	A total of 113 automotive suppliers in Malaysia/ survey	Both reverse-logistics-based product returns and product recovery are positively related to financial performance
Morais *et al.* (2018)	Financial performance			Aluminum producer in Brazil/case study	Reverse logistics can achieve considerable savings in financial resources
Slomski *et al.* (2018)	Financial performance, environmental performance, social performance			Manufacturer in Brazil/case study	Reverse logistics contributes positively to financial, environmental and social goals
Morgan *et al.* (2018)	Operational performance			In total, 180 firms in the USA/survey	Sustainable reverse logistics capability is positively related to operational performance

(*continued*)

Author	Outcome	Moderator/mediator	Theory	Context/methods	Findings
Siew *et al.* (2016)	Environmental outcome; sales disposition; business growth	Institutional pressure	Resource-based view	A total of 89 Malaysian EEE manufacturers/survey	Under institutional pressure, the use of disposition options results in increased performance levels in some cases. Product recovery enhanced environmental and economic benefits. Conversely, product recycling and disposal activities are not necessarily performance inducing initiatives in the face of regulatory pressures
Hazen *et al.* (2015)	Cost-effectiveness		Resource-based view	A total of 135 firms in the USA/survey	Reverse logistics enhances cost-effectiveness
Lai *et al.* (2013)	Environmental, financial and social performance		Theory of Production Frontier	Export-oriented manufacturers in China/survey	Reverse logistics positively affects environmental and financial performance but does not affect social performance
Ye *et al.* (2013)	Economic performance; environmental performance			A total of 609 firms in China/survey	Product recovery is positively related to economic and environmental performance, but product returns negatively affect a firm's economic performance and do not affect environmental performance
Škapa and Klapalová (2012)	Profitability			A total of 102 companies in the Czech Republic/survey	A third of respondent companies reported positive benefits of reverse logistics. Others reported negative and nonsignificant impacts of reverse logistics

Notes: EEE = electrical and electronic equipment
Source: Created by authors

Table 1.

these barriers, firms must unlearn and relearn several important competencies and develop new skills and knowledge (Rasool *et al.*, 2023). Increasingly, digital information technology (IT) capabilities – the ability to use technological applications to create value for customers, suppliers and the firm itself – have become crucial in businesses' operations (Proksch *et al.*, 2021). Technological advancements in business analytics tools and methods provide unprecedented access to vast amounts of data beyond the firms' business transactions – big data (Lehrer *et al.*, 2018). There has been an upward trend in the role of analytics in businesses. Several studies have examined how big data and supply chain analytics contribute to business performance (Li *et al.*, 2023; Wamba *et al.*, 2018).

Analytics capability is conceptualized in this study as the firm's ability to "process large volumes and varieties of data with the velocity required to gain relevant insights" (Appiah, 2024). In the manufacturing industry, analytics capability is the firm's capability that enables it to collect, store, analyze and process immense volume, variety and velocity of data across different partners to enhance data-driven decision-making and discover business values and insights in a timely fashion (Yu *et al.*, 2021). The analytics capability can help process, organize, visualize and analyze information from internal and external sources to run the reverse logistics process effectively (Liu and Wei, 2022). Businesses with high analytics capability obtain crucial insights into their operations that improve decision-making. Firms with an analytics capability can sense, gather, analyze, assimilate and transmit data from internal and external sources to create meaningful decision-making models (Liu and Wei, 2022).

Because the business environment in developing countries is characterized by significant informal trading mechanisms, poor supply chain transparency and limited information flow, firms require extensive information processing capabilities to coordinate reverse logistics efforts successfully (Ni *et al.*, 2021). This requires firms to develop competencies that can overcome the high scales introduced by the informational voids (Bouchenine and Abdel-aal, 2023; Rasool *et al.*, 2023). Reverse logistic flows are characterized by high variability, which suggests that information system capabilities are essential for managing reverse logistics processes (Hazen *et al.*, 2015). Analytics capability can help process large volumes, high velocity and several varieties of data to extract meaningful and valuable insights (Wamba *et al.*, 2018) to support reverse logistics. By building analytics capabilities, firms can apply various data visualization, tracing and analytical tools to map their reverse logistics networks efficiently.

3. Theory and hypothesis

3.1 Organizational information processing theory

OIPT emphasizes that information processing organizational design should emphasize reducing uncertainty. Uncertainty, as used in this context, refers to the disparity between the amount of information required to perform a task and the amount of information an organization already possesses (Haußmann *et al.*, 2012). The existence of uncertainties requires organizations to reduce their information processing needs and/or increase their information processing capacities (Yu *et al.*, 2019). The information processing capacity refers to the organization's capability to gather, interpret and summarize information to support decision-making (Zhu *et al.*, 2018). This suggests that the level of environmental uncertainty is positively related to the firm's information processing needs. Therefore, as the level of uncertainty increases, firms must enhance their information processing capacity to match the information needs (Yu *et al.*, 2019). Firms that can obtain a "fit" between their information processing capacity and their information processing needs can attain desirable performance (Pu and Qiao, 2023).

OIPT further suggests that information technology is an effective tool to enhance an organization's information-gathering, processing and sharing capabilities (Gu *et al.*, 2021). The nature of reverse logistics in low-resource contexts creates information processing demands that require firms to develop information processing capabilities. OIPT suggests that firms can mitigate the impact of uncertainties by improving their information processing capability (Galbraith, 1974). Firms implementing reverse logistics in low-resource contexts need streamlined information to help synchronize decisions and coordinate actions across fragmented supply chains.

This study draws on the OIPT to argue that firms can improve their financial gains from reverse logistics by reducing the uncertainties in reverse movement. These uncertainties include limited documentation, difficult traceability patterns and limited partner integration. Due to fragmentation in the supply chains, a vast amount of data about the reverse logistics network exists at different stages. Managing such data requires organizations to possess advanced information processing capabilities from which they can derive valuable insights for better decision-making (Zhu *et al.*, 2018). Therefore, firms with high analytics capabilities can leverage it to reduce reverse logistics information processing needs and increase their financial performance. OIPT has been used several times to examine how firms can adapt information technology and/or information systems and their related capabilities for organizational performance (Haußmann *et al.*, 2012).

3.2 Reverse logistics and financial performance

Reverse logistics systems have significant potential to enhance financial performance in several ways. First, returns for recycling and reuse enable businesses to reduce material consumption and optimize resource usage to decrease production costs (Rogers and Lembke, 2021). Also, firms that engage in reverse logistics obtain environmental credibility that can attract the attention of environmentally conscious customers and lead to increased patronage and profitability (Kalubanga and Mbekeka, 2023). Effective reverse logistics allows a company to take advantage of inventory reduction and distribution cost savings and improve customer satisfaction (Huang and Yang, 2014). Reverse logistics also might enhance customer loyalty because customers respond positively to environmentally responsible actions by the firm, so goodwill generated by reverse logistics could be a source of firm competitiveness (Hsu *et al.*, 2016). They also improve firms' economic sustainability by increasing revenue, market shares and customer satisfaction by creating product choices and offering products at various quality levels for a reduced price (Das and Hall, 2020).

However, especially for firms in frontier economies, reverse logistics systems pose significant challenges that can negatively affect their financial performance (Fernando and Abideen, 2021). Reverse logistics costs are significantly higher for firms in developing countries than those in developed economies (Waqas *et al.*, 2018). First, many firms operate in the informal sector with little documentation on logistics and/or goods-handling procedures (Zoogah, 2018). Therefore, there is limited data on product movements and exchanges between parties in the various supply chains. Further, poor communication and transport infrastructure significantly add to the costs of disseminating information and transportation products back into the supply chain (Appiah, 2024). Again, consumer attention toward corporate environmentalism is limited, so firms are less likely to gain consumers' favor by implementing reverse logistics schemes (Appiah, 2023). Regulatory schemes are also weak and offer limited support to firms that engage in environmental sustainability and/or diligent customer service (Boso *et al.*, 2023). Because many firms can elude the gaze of the law, it is unattractive for many firms to join the reverse logistics movement. Significant costs are associated with the reverse movement due to fragmentations in supply chains (Shahidzadeh and Shokouhyar, 2022). Empirical evidence suggests that reverse logistics programs, by themselves, may not necessarily enhance financial performance (Ye *et al.*, 2013) and may even contribute to negative economic returns (Li *et al.*, 2023).

Based on this premise, this study argues that:

H1. In developing economies, reverse logistics implementation is negatively related to financial performance.

3.3 The moderating role of analytics capability

Reverse logistics processes are impacted by the overall environment in which they occur; this environment is known as the entrepreneurial ecosystem (Wilson *et al.*, 2022). Analytics capability describes the firm's ability to organize, analyze and draw insights from data (Liu and Wei, 2022). Because reverse logistics activities are quite complex and highly uncertain (Wadhwa and Madaan, 2007; Hanafi *et al.*, 2008), the firm must be able to generate new knowledge to reduce uncertainty and improve responsiveness to continuing changes in reverse logistics systems (Ramírez, 2012). Though necessary, implementing and managing reverse logistics is not easy and requires significantly more resources and expertise than forward logistics to manage and implement successfully (Rasool *et al.*, 2023). Such a process includes building an appropriate infrastructure, IT capabilities and culture to share information with internal and external partners (Yaspal *et al.*, 2023). To overcome these barriers, firms must unlearn and relearn several important competencies and develop new skills and knowledge (Rasool *et al.*, 2023). Because return flows are often characterized by high variability, research suggests that information system capabilities are essential for managing reverse logistics processes (Hazen *et al.*, 2015).

Extant research suggests that reverse logistics has benefits and risks for the financial performance of an entity (Govindan and Soleimani, 2016). This study argues that the extent to which a firm benefits or suffers financially due to its reverse logistics is contingent on analytics capability. The limited documentation and knowledge systems on reverse logistics in frontier economies increase the information processing requirements of these systems (Galbraith, 1974). This requires that firms develop capabilities in information gathering, exploitation and dissemination to increase the chances of success (Qrunfleh and Tarafdar, 2014). Reverse systems that include predetermined dispositions are almost always better than deciding where to send the item after it arrives at the place where it is being sorted (Rogers and Lembke, 2021). When deploying reverse logistics systems, firms can manage their financial performance through resource efficiency (Kumar *et al.*, 2023), associated with the availability of information that can help make optimized decisions. Because return flows are often characterized by high variability, research suggests that information system capabilities are essential for managing reverse logistics processes (Hazen *et al.*, 2015).

Firms with low analytics capability will likely have inefficiencies across the reverse logistics networks, leading to significant cost increases (Zhu *et al.*, 2018). These inefficiencies can stem from using suboptimal routes, being unable to preplan product recalls due to limited information and overspending on field activities instead of planning (Rogers *et al.*, 2012). These cost increases result from their limited capacity to collect and analyze information across the supply chain network to use in the reverse logistics setup (Wilson and Goffnett, 2022). For instance, during product recall, a firm with low analytics capability will likely use field forces that move from one retail shop to another looking for the affected product batches due to limited documentation and information transmission in the supply chain. This can significantly increase the cost and time associated with the recall, which will likely decrease financial performance.

Conversely, firms with high analytics capability can match the information processing needs of reverse logistics in these frontier economies. Knowledge management is important in reducing the high degree of uncertainty in reverse logistics processes (Ramírez, 2012). Such firms can collect, store and process data on the reverse logistics network that can be used to optimize decision-making (Kazancoglu *et al.*, 2023). During product recalls, for example, firms with high analytics capability can obtain data on product movements throughout the supply chain. This data helps in prior planning of the recall process and helps make focused decisions that minimize costs. The timeliness in action could also enhance the satisfaction of downstream partners to encourage future sales. Additionally, firms with high analytics capability can preplan routes, storage centers and partner collaborations that increase the value obtained from reverse logistics activities (Wu, 2022). Firms with high analytics capability tend to create more value with their reverse logistics systems, which may improve their financial performance.

Based on these arguments, this study hypothesizes that:

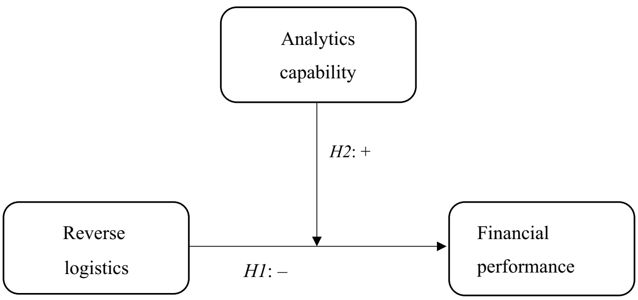
H2. Analytics capability moderates the relationship between reverse logistics and financial performance such that higher levels of analytics capability induce a stronger positive financial performance than lower levels of analytics capability.

The research model is presented in Figure 1.

4. Methods

4.1 Research context

This research was conducted in Ghana's manufacturing industry. This context is suitable for the current research for several reasons. There are increasing concerns about environmental sustainability among businesses in Ghana following recent environmental challenges due to illegal mining and flooding in major cities in rainy seasons due to poor drainage caused mainly by waste disposal in drainage systems. Reverse logistics systems contribute significantly to waste management (Li *et al.*, 2023). Ghana generates about 12,170 tonnes of solid waste daily, of which only 10% is collected and disposed of properly (UNDP, 2022). Ghana was ranked 157th out of 170 firms across the globe in the environmental performance index by Yale University (Wolf *et al.*, 2022), indicating significant environmental challenges in the country. Recognizing the increasing challenge with waste management in the country, the Government of Ghana introduced the National plastic



Source: Created by authors

Figure 1.
Research model

management policy in 2015 primarily because "plastics have been indiscriminately disposed into our water bodies resulting in perennial floods across the country" (MESTI, 2020). Also, many businesses in Ghana are beginning to embrace the concept of sustainability. Empirical evidence suggests that corporate environmentalism is on the rise, and there is an upward trend of green marketing among businesses in Ghana (Agyabeng-Mensah *et al.*, 2022; Asamoah *et al.*, 2023). While governmental policies can spur environmental management practices such as reverse logistics, these practices can be sustained over time when they can enhance profitability (Forsman, 2013). However, extant research suggests that the financial outcome of environmental policies differs among contexts (Yao *et al.*, 2019). For instance, reverse logistics requires strategic and seamless information sharing, capturing, processing and retrieval to track, trace and return products to the supply chain (Demajorovic *et al.*, 2016; Ni *et al.*, 2021). However, firms in developing countries operate in less formalized economies with low supply chain integration, poor data capturing and processing systems and low expertise in supply chain traceability, which increases the resource requirements of reverse logistics (Rasool *et al.*, 2023; Vlachos, 2016; Ye *et al.*, 2013) which increases the cost of running operations and reducing financial performance (Waqas *et al.*, 2018). Overall, the state of business in this context suggests that environmental management practices have become imperative, although the outcomes of these practices have yet to be fully understood. Therefore, this study examines how firms' reverse logistics systems impact their financial performance and what conditions they can benefit from.

4.2 Sampling and data collection

The data for testing this research model was gathered through a questionnaire survey of manufacturing companies in Ghana. The data is part of a large-scale data collection on sustainability, resilience and organizational performance in 2023. Firms in the Ashanti and Greater Accra regions – the two most industrialized countries – were the focus of this study. The research targeted electronics, bottled and plastic-producing companies requiring reverse logistics functions. Given the difficulty of obtaining a sampling frame in the context, a list of firms was obtained from an online directory that included 274 firms in the target category. Trained field agents approached all 274 firms to respond to the questionnaire. To facilitate access to the firms and assure participants of confidential and strictly academic use of the collected data, each field agent had an introductory letter signed by the researcher and the dean of faculty.

Two respondents were targeted in each organization to minimize common method bias associated with using single respondents in surveys (Podsakoff *et al.*, 2003). The performance aspect of the questionnaire was separated from the other variables and was obtained from finance and/or accounting managers. The other items, which included sustainability and resilience constructs, were sourced mainly from general managers, supply chain managers and, where available, quality, environment and safety managers.

Following several rounds of reminders, 208 questionnaires were retrieved. However, only 200 responses were deemed usable after a face check for completeness and physical condition of the returned questionnaires. An independent sample *t*-test between early and late respondents (using the first 10% received and the last 10% received) revealed no statistically significant difference between early and late respondents. This suggests, in line with previous research, that nonresponse bias is not a major concern for this study (Armstrong and Overton, 1977).

Table 2 presents details of the respondent's characteristics. The primary respondent's position refers to the respondent's position in other parts of the questionnaire besides the financial performance section, which was detached and presented only to finance experts. However, about 12 firms did not have a designated financial manager/supervisor/accountant position; therefore, the primary respondent also filled the financial performance section. This accounts for only 6% of the responding organizations and thus will not introduce substantial bias into the study. Other characteristics of the respondents and the organizations, such as the respondents' years of experience in both their current position and in their current industry, are presented in Table 2, together with the firm size and how long the firm has operated (firm age).

4.3 Measures

This study conceptualizes reverse logistics as the extent to which the firm supports returning products or packaging after customer use for reuse, recycling or reclamation (Hsu *et al.*, 2008). Three items adapted from Hsu *et al.* (2008) measure firms' reverse logistics activities. We asked respondents to rate the extent to which their organization implements the indicated reverse logistics practices on a scale of one to seven.

Analytics capability measures the extent to which firms use data management and analytical techniques. This study adopts five items from Liu and Wei (2022) to measure analytics capability. Respondents were asked to rate on a scale of one to seven the extent to which their organization uses the tools indicated in running their business operations.

Financial performance is measured using four items generically used to capture subjective financial performance in the sustainability literature adapted from Danso *et al.* (2019). Respondents were asked to rate, on a scale of one to seven, the extent to which their firm has performed relative to their competitor on these dimensions. Whereas objective financial measures are arguably better for capturing the true state of a firm's financial performance, obtaining such measures is extremely difficult in this context, especially for small and medium enterprises that are not required by law to release official financial statements.

The model controls for the effect of firm size because larger firms have more resources and are expected to obtain higher financial performance. Firm size is measured in terms of the number of full-time employees. Table 3 presents details of the measurement items and their sources.

5. Data analysis

Partial least squares structural equations modeling using SMART PLS 3 was used to examine the measurement and structural models. SMART PLS examines both the measurement and the structural model concurrently. Due to its ability to produce consistent estimates for small sample sizes and nonnormal data, PLS estimation is often preferred over covariance-based SEM for data obtained in less formal contexts (Hair *et al.*, 2017). The

Variable	*N*		%	
Primary respondent's position				
CEO	42		21	
General manager	60		30	
Supply chain manager	60		30	
Environmental/quality manager	38		19	
	Min	Max	Mean	SD
Respondent's industry experience	3	23	10.08	3.76
Respondent's position experience	2	20	8.34	3.54
Number of employees	4	352	32.45	43.58
Firm age	4	17	10.75	4.07

Note: CEO = chief executive officer
Source:

Table 2. Respondent and firm characteristics

Table 3.
Measurement items and sources

Items	Source
Reverse logistics	
RL1. We collect used products and/or packaging from customers for recycling	Hsu *et al.* (2008)
RL2. We encourage customers to return used/unwanted products for safe disposal	
RL3. We recall unsafe/unwholesome products from customers	
Analytics capability	
AC1. We use advanced analytical techniques (e.g. simulation, optimization and regression) to improve decision-making	Liu and Wei (2022)
AC2. We easily combine and integrate information from many data sources for use in our decision-making	
AC3. We routinely use data visualization techniques (e.g. dashboards) to assist users or decision-makers in understanding complex information	
AC4. Our dashboards give us the ability to decompose information to help root cause analysis and continuous improvement	
AC5. We deploy dashboard applications/information to our managers' communication devices (e.g. smartphones and computers)	
Financial performance	
FPERF1. Overall profitability	Danso *et al.* (2019)
FPERF2. Net profit margin	
FPERF3. Return on investment (ROI)	
FPERF4. Return on assets (ROA)	

Source: Created by authors

Hayes PROCESS macro used the Johnson–Neyman (J-N) technique to probe the moderation effects further. Hayes PROCESS is a tool that has been used several to probe mediation, moderation and conditional process models. Several researchers chose this tool due to its simplicity and ability to return higher-level statistical results on interaction effects.

5.1 Measurement model

The factor loadings for each measurement item are presented in Table 4. The loadings are satisfactory, as all loadings are above the recommended threshold of 0.7, except for the RL 3.

Table 4.
Factor loadings

Item	Analytics capability	Financial performance	Reverse logistics
AC1	0.823		
AC2	0.790		
AC3	0.837		
AC4	0.850		
AC5	0.852		
FPERF1		0.771	
FPERF2		0.865	
FPERF3		0.712	
FPERF4		0.830	
RL1			0.881
RL2			0.831
RL3			0.619

Source: Created by authors

Given that the reverse logistics construct is fairly new to the context being used, a loading of 0.6 is considered acceptable (Hair *et al.*, 2019).

Table 5 presents the tests of internal consistency and convergent validity. The results show that Cronbach's alpha (CA) is greater than 0.80 for analytics capability and financial performance, while it is 0.695 for reverse logistics. Given that the reverse logistics construct is being used in a new context, a CA value close to 0.7 is acceptable. Further, composite reliability (CR) for all constructs, which considers the error terms and is often considered superior to the CA, is above 0.7 for all constructs, providing further evidence of the internal consistency of the items (Hair *et al.*, 2019). The average variance extracted (AVE) values are also above 0.5, supporting the claims of convergent validity among the measurement items (Hair *et al.*, 2019).

This study demonstrates discriminant validity in three ways. First, the Fornell–Lacker criterion compares the AVEs to the highest correlations interconstructs. The correlation matrix provided in Table 6 shows that the AVE values (presented in italics on the diagonal) are higher than the interconstruct correlations for each construct. Also, the Heterotrait-monotrait ratio produced by SMART PLS shows that the highest value is 0.393, below the threshold of 0.8 to support the discriminant validity of the constructs (Benitez *et al.*, 2020). Further, Table 7 presents the cross-loadings of the measurement items to each construct. The results show that items load significantly on their respective constructs (as seen by the italicized loadings) and poorly on all other constructs, further supporting discriminant validity.

5.2 Structural model

The results of the PLS path analysis are summarized in Table 8. Reverse logistics accounts for 22.4% of the variance in financial performance. Consistent with social science research, the criteria for substantial results is a 5% significance level for a two-tailed test (p-value $\leq$ 0.05). The results show that reverse logistics is negatively related to financial performance ($\beta = -0.193$, $t = -3.122$). The result is significant at 5% (p-value $= 0.002$).

Construct	CA	CR	(AVE)
Analytics capability	0.890	0.917	0.690
Financial performance	0.809	0.874	0.635
Reverse logistics	0.695	0.825	0.617

Source: Created by authors

Table 5. Internal consistency and convergent validity tests

Variables	1	2	3	4
1. Analytics capability	*0.690*			
2. Financial performance	0.147*	*0.635*		
3. Reverse logistics	−0.043	−0.287**	*0.617*	
4. Firm size	0.268**	0.149*	−0.169*	n/a

Notes: *Correlation is significant at the 0.05 level (two-tailed); **Correlation is significant at the 0.01 level (two-tailed); AVE values are presented on the diagonal
Source: Created by authors

Table 6. Correlation matrix and discriminant validity

Items	Analytics capability	Financial performance	Reverse logistics
AC1	*0.823*	0.190	−0.006
AC2	*0.790*	0.123	0.092
AC3	*0.837*	0.106	0.003
AC4	*0.850*	0.093	−0.050
AC5	*0.852*	0.168	−0.151
FPERF1	0.315	*0.771*	−0.176
FPERF2	0.111	*0.865*	−0.301
FPERF3	0.043	*0.712*	−0.196
FPERF4	0.055	*0.830*	−0.275
RL1	0.020	−0.298	*0.881*
RL2	−0.053	−0.235	*0.831*
RL3	−0.087	−0.141	*0.619*

Source: Created by authors

Table 7.
Cross loadings

Path	β	t-value	p-values	Decision
Firm size → FPERF	0.127	1.961	0.050	
Analytics capability (AC) → FPERF	0.168	2.202	0.028	
Reverse logistics (RL) → FPERF(*H1*)	−0.193	−3.122	0.002	Supported
RL × AC → FPERF(*H2*)	0.346	4.312	0.000	Supported

Note: FPERF = financial performance
Source: Created by authors

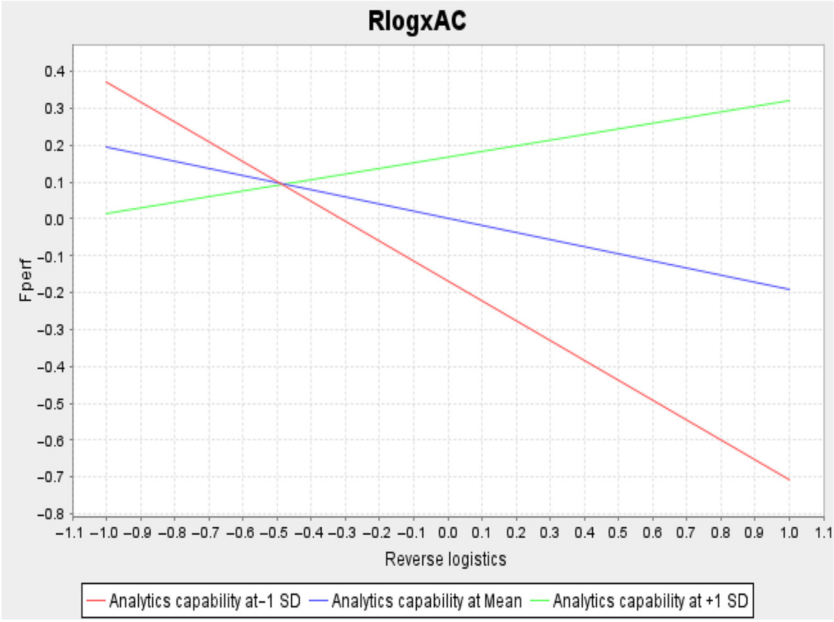
Table 8.
Hypothesis tests

This supports hypothesis one of the study. The results further show that analytics capability positively moderates the relationship between reverse logistics and financial performance ($\beta = 0.345$, $t = 4.322$), and this result is also significant at 5% (p-value = 0.001). This also supports hypothesis two of the study.

To further examine the nature of the moderation effect, Figure 2 presents a plot of the interaction using the simple slope analysis procedure in SMART PLS. The slopes are plotted at values in the range of ± 1 standard deviation of the mean. The results from Figure 2 show that whereas reverse logistics is positively associated with financial performance under high levels (+1 SD) of analytics capability, the same relationship is negative under low levels of analytics capability (–1 SD).

The J-N technique is used to investigate the relationship between reverse logistics and financial performance at all levels of analytics capability. The J-N technique helps to overcome the arbitrary selection of points in the simple slope analysis procedure. Table 9 presents the J-N analysis produced by Hayes PROCESS to examine the conditional effect of reverse logistics on financial performance at values of analytics capability. The significance of the relationship at each level is tested using a 10,000-sample bias-corrected bootstrapping procedure.

The shaded portions in Table 9 represent the areas of significance. This suggests that at levels of analytics capability 3.8 and below (on the seven-point measurement scale), the relationship between reverse logistics and financial performance is negative and significant. However, at levels of analytics 5.3 and above (on the seven-point measurement scale), the relationship between reverse logistics is positive and significant. This suggests that, given the same level of reverse logistics, firms with high analytics capability are more likely to improve their financial performance. In contrast, firms with low analytics capability will likely reduce their financial performance.



Source: Created by authors

Figure 2. Interaction plot

6. Discussions and theoretical implications

This research addresses two important relationships using the OIPT. The study examines the financial outcome of reverse logistics and the conditions under which firms in developing countries benefit from reverse logistics implementation. The findings suggest a negative relationship between reverse logistics and financial performance. The findings further depict that the firm's analytics capability positively moderates the relationship between reverse logistics and financial performance. When this moderation is probed, the findings show a positive relationship between reverse logistics and financial performance for firms that reported high analytics capability. However, the relationship between reverse logistics and analytics capability is negative for firms with low analytics capability. The theoretical and practical implications have been outlined in the subsequent subsections.

6.1 Theoretical implication

The results suggest a negative relationship between reverse logistics and financial performance. From a sustainability standpoint, much of the extant literature has echoed the efficacy of reverse logistics to save the firm's image, save cost, increase operational performance and attract a broader consumer base to increase financial performance (Fernando and Abideen, 2021). The current result, however, is in line with the findings of Li *et al.* (2023) and Ye *et al.* (2013) that reverse logistics could have undesirable financial outcomes. The cost implications of running reverse logistics could outweigh its financial outcomes (Mallick *et al.*, 2023). Therefore, the results of this research provide a reality check on the cost implications of reverse logistics systems, particularly in developing economies. Although much of the discussion of reverse logistics in the modern sustainability literature has focused on its environmental and social benefits, "whether it pays to be green" is still a

AC	Effect	S.E	*t*-value	*p*-value	LLCI	ULCI
1.0	−1.0628	0.1651	−6.4374	0.0000	−1.3884	−0.7372
1.3	−0.9728	0.1494	−6.5117	0.0000	−1.2674	−0.6781
1.6	−0.8827	0.1341	−6.5830	0.0000	−1.1472	−0.6183
1.9	−0.7926	0.1194	−6.6404	0.0000	−1.0281	−0.5572
2.1	−0.7026	0.1055	−6.6619	0.0000	−0.9106	−0.4946
2.4	−0.6125	0.0927	−6.6045	0.0000	−0.7954	−0.4296
2.7	−0.5225	0.0818	−6.3899	0.0000	−0.6837	−0.3612
3.0	−0.4324	0.0733	−5.8981	0.0000	−0.5770	−0.2878
3.3	−0.3424	0.0683	−5.0101	0.0000	−0.4771	−0.2076
3.6	−0.2523	0.0676	−3.7325	0000	−0.3856	−0.1190
3.8	−0.1622	0.0712	−2.2777	0.0002	−0.3027	−0.0218
3.9	−0.1430	0.0725	−1.9722	0.0238	−0.2861	0.0000
4.1	−0.0722	0.0786	−0.9179	0.0500	−0.2273	0.0829
4.4	0.0179	0.0889	0.2012	0.3598	−0.1574	0.1932
4.7	0.1079	0.1011	1.0678	0.8408	−0.0914	0.3073
5.0	0.1980	0.1146	1.7270	0.2870	−0.0281	0.4241
5.1	0.2389	0.1211	1.9722	0.0858	0.0000	0.4778
5.3	0.2881	0.1291	2.2307	0.0500	0.0334	0.5427
5.5	0.3781	0.1443	2.6211	0.0268	0.0936	0.6626
5.8	0.4682	0.1598	2.9289	0.0095	0.1529	0.7834
6.1	0.5582	0.1758	3.1758	0.0038	0.2116	0.9049
6.4	0.6483	0.1920	3.3772	0.0017	0.2697	1.0269

Notes: LLCI = lower limit confidence interval; ULCI = upper limit confidence interval
Source:

Table 9. Conditional effect of focal predictor at values of the moderator

managerial dilemma that underlines several environmental strategies in boardrooms (Škapa and Klapalová, 2012). This consideration is magnified for firms in developing economies with weak regulations and low levels of green consumerism (Appiah, 2023; Pujiati *et al.*, 2023). This study's findings introduce a potential "dark side" of reverse logistics systems from a financial perspective into the empirical literature.

Second, drawing on the OIPT, this study proposes, tests and confirms that analytics capability positively moderates the relationship between reverse logistics and financial performance. The results suggest that analytics capability helps attenuate reverse logistics's negative impact on financial performance. These results offer a novel perspective on how firms can optimize their reverse logistics structures to ensure they reap financial gains. Reverse logistics is fast becoming a compulsion for firms due to increasing regulation and consumer demand, even in developing countries (Kumar *et al.*, 2023). The literature has established that firms require specific competencies to navigate the complexity of reverse logistics (Fernando and Abideen, 2021; Ramírez, 2012). This study contributes to knowledge on analytics capability as a specific competency firm can develop to gain financial from their reverse logistics investment. The findings suggest that firms implementing reverse logistics with low analytics capability could miss out on efficiency gains that can be made by collecting and processing information that can help optimize the routes and agents for successful reverse logistics (Yaspal *et al.*, 2023). These firms could be overwhelmed with the information processing requirements of the reverse logistics process, leading to suboptimal decision-making and high operational costs (Appiah, 2024). Conversely, high analytics capability supports information capture, transmission, analysis and dissemination (Wamba *et al.*, 2018), which can help the optimal development of logistics networks to support reverse logistics systems. This can reduce costs, minimize disappointments and create higher values that enhance financial performance. The findings support extant research that calls for businesses to use emerging data analytics systems to improve information processing (Lin and Kunnathur, 2019; Zhu *et al.*, 2018).

Third, this study uses data from a context that has just begun to encourage environmental management initiatives. The findings reflect the unique setting of this research and, therefore, distinguish these findings from those reported in earlier studies conducted in developed settings. This is because the information processing needs of firms operating in less formalized environments are higher, and therefore, reverse logistics systems are more costly and practically challenging to operate (Appiah, 2024). In settings with little computerization of retail sales, lack of formal documentation procedures, poor road networks and generally little understanding among smaller actors on supply chain management, focal manufacturers that implement reverse logistics systems seem to have higher hurdles to overcome than their counterparts in other settings (Andersen *et al.*, 2022). This study's findings suggest that while the cost of "formalizing" this informal context could be substantially higher than the gains made from reverse logistics, analytics capability could enable the firms to process this formalization to increase the value created efficiently. Analytics capability could improve the traceability of supply chains in developing countries to improve the efficiency of reverse logistics processes (Dubey *et al.*, 2021). This study draws attention to the heightened information processing needs of firms operating in such contexts.

Overall, this paper contributes to the reverse logistics and broader sustainability literature in three ways. First, while many scholars provide theoretical explanations for how firms benefit from reverse logistics systems, only a few collect and test empirical data. This study provides limited empirical evidence on the financial benefits of reverse logistics systems, and the existing findings remain equivocal (Kazemi *et al.*, 2018). Second, the paper contributes to knowledge of the information processing needs required for successful reverse logistics systems (Hazen *et al.*, 2015). This paper explains how analytics capabilities condition the relationship between reverse logistics and financial performance in developing countries. Third, this study explores the uniqueness of the context and explains the additional information processing burden placed on firms. This potentially opens an avenue for future discussions on how reverse logistics systems in formalized economies differ from frontier economies.

6.2 Managerial implication

The implication of these findings for managerial decision-making is outlined in the following paragraphs.

First, managers in resource-constrained and less formalized settings need to understand that despite the potential for reverse logistics and the persistent calls for reverse logistics systems as part of the broader sustainability agenda, there is a potential financial downside to these systems and that firms require careful planning and analysis during implementation. Therefore, managers should intensify stakeholder engagement, especially with supply chain actors, to identify the potential risks associated with these systems and identify areas that are candidates for efficiency gains. The planning should include detailed supply chain mapping and simulation systems to reduce the uncertainty of reverse logistics.

Second, managers should understand that reverse logistics systems need the commitment of resources and attention, just as forward logistics, to obtain financial benefits. Because reverse logistics systems differ from forward logistics, a deliberate attempt should be made to develop a specific reverse logistics strategy, as extant research suggests that firms that seek to use their forward logistics strategy for reverse logistics are likely to fail (Rogers *et al.*, 2012). The strategy should outline clearly the intention of the reverse logistics system and its inventory, transportation and handling systems.

Third, managers in such contexts should seek to develop firm-wide analytics capability to support the information processing needs of reverse logistics systems. Companies most often need a way to deal with the large volume of information and options associated with reverse logistics. Analytics capability is helpful for managers to identify, collect, use and disseminate information related to the location and routes of product movements in the reverse process. Managers should invest in appropriate information capturing and dissemination technology to develop analytics capability, train all staff on analytics and incorporate data-driven decision-making in standard operating procedures.

Our research helps firms circumvent the financial challenges accompanying reverse logistics implementation. Our research divulges reverse logistics as a two-edged sword that can either enhance financial performance or worsen the firm's financial situation. Consequently, we propose that firms seeking to invest in reverse logistics must additionally develop analytics capabilities that will enable them deal with the information processing requirements of running a cost-effective reverse logistics system in a developing country.

6.3 Policy implications

The findings also have implications for policy development to support reverse logistics and the general sustainability agenda in developing economies.

First, because reverse logistics is associated with negative financial performance, governments in developing countries should incentivize firms seeking to implement reverse logistics strategies. Incentives such as subsidies, tax rebates and state awards could motivate increased firm attention toward reverse logistics. These incentives could propel countries toward the sustainable development goals of environmental management.

Second, policymakers should create long-term investment plans to develop technological tools in the macroenvironment to support firms that seek to deploy these technologies to support reverse logistics. Governments should also promote private investment in communication technologies to provide easy access to firms seeking to deploy technological support for their reverse logistics operations. Voids in the business environment owing to limited infrastructure will likely hinder firms' ability to nurture the analytics capability required to implement reverse logistics successfully.

7. Conclusion and limitations

This study has examined the relationship between reverse logistics and financial performance under varying conditions of analytics capability. Drawing on the OIPT and using survey data from 200 firms in Ghana, the findings suggest that analytics capability positively moderates the relationship between reverse logistics and financial performance. Despite the contributions made in this study, some limitations could inform future studies.

First, the study uses survey data from Ghana, a sub-Saharan African country. Although this context can be likened to other resource-constrained settings, especially in sub-Saharan Africa, readers must still be careful when generalizing. Future studies can be conducted in similar contexts to further validate the relationships identified in this study.

Second, despite using two respondents to overcome common method variance, there are still concerns about using self-reported survey data to test relationships. Using objective data in future studies will provide more insights into the proposed relationships. For instance, using actual data from financial records instead of self-reported financial performance can be helpful.

Third, because reverse logistics can be resource-intensive, future studies must consider the role of slack resources in the current model to understand how firms in resource-constrained settings accumulate resources to invest in reverse logistics and the outcomes of such accumulation.

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