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A comparison of the environmental sustainability of brick-and-mortar retailing and online retailing: Contrasting academic research and consumer perceptions

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Abstract

Sustainability has become paramount in society and retail. Therefore, this study aims to compare the environmental sustainability of brick-and-mortar retail and e-commerce. A literature review identifies various factors, such as buildings, shopping trips, order bundling, returns, packaging, transport and logistics, and environmentally conscious behavior, that determine the channel that is superior in terms of environmental sustainability. While these factors are context-specific and depend on several actors (e.g., consumers, retailers, and logistics service providers), most studies consider e-commerce to be more environmentally friendly than purchases from brick-and-mortar stores. However, this review demonstrates that most previous studies have focused on objective criteria (e.g., CO_2). Therefore, to reflect the importance of consumers' perspectives on channel choice, we conducted four empirical studies that provide insights into the perceived environmental sustainability of each channel. In contrast to experts' views, consumers perceive e-commerce as less sustainable than brick-and-mortar retailing. Hence, online retailers should improve their communication

strategies and highlight the potential environmental advantages of e-commerce and omni-channel retailing. Brick-and-mortar retailers are advised to reduce the environmental damage they cause and encourage their customers to act in an eco-friendly manner.

KEYWORDS

brick-and-mortar retailing, e-commerce, environmental sustainability

1 | INTRODUCTION

Sustainability has become a crucial prerequisite for the retail sector (Carling et al., 2015). In particular, environmental issues are important for retailers and consumers, as they influence consumers' purchase decisions, increase their willingness to pay, and positively impact the image of products sold and retailer brand (e.g., Carrillo et al., 2014; Hetterich et al., 2012). Therefore, environmental sustainability is an important element for retailers in defining their market positions (Kumar & Ghodeswar, 2015; Mangiaracina et al., 2016).

The need for more sustainability equally applies to both the brick-and-mortar (B&M) channel and e-commerce (EC) as a distribution channel. The significant shift towards online shopping (Choi et al., 2019), which has been further triggered by COVID-19 (Feichtinger & Gronalt, 2021), raises the question of how shopping via B&M or EC compares in terms of their environmental sustainability. For instance, studies demonstrate that consumers are aware of the positive and negative environmental aspects of EC but are willing to inform themselves further and thus include the underlying activities of retailers, such as transport and warehousing, in their purchasing decisions on the basis of their environmental performance (Rao et al., 2021). Moreover, a large proportion of consumers choose the B&M channel over EC for green products (Wang et al., 2019), which further indicates the need to distinguish between these channels. Nevertheless, the increasing environmental awareness of consumers is important in EC and B&M, resulting in a demand for retailers who act more ecologically and responsibly (Cheung & To, 2021; Oláh et al., 2019). Consequently, many recent empirical studies have examined the environmental dimension of the sustainability of the B&M and EC channels by comparing them as distribution channels (e.g., Mangiaracina et al., 2016; Pålsson et al., 2017; Siragusa & Tumino, 2021). Further research that compares B&M and EC channels from a consumer perspective, in addition to the objective measurements mostly used in the scientific literature is required (e.g., Trott et al., 2020). Especially as consumers' perceived sustainability of a specific distribution channel may differ from an objective measurement and is likely to have a stronger impact on their channel choice than purely objective measurements, which are probably unknown to customers (Latif et al., 2019; Otto et al., 2021; Wiese et al., 2012). Addressing the sustainability of a distribution channel from consumers' perspective adds considerable value to prior research, as customers' perceptions do not necessarily have to coincide with an objective perspective. Considering the comparison between objective analysis and the consumer perspective of the two channels (B&M and EC) in terms of environmental sustainability closes the research gap.

This study's aim therefore is twofold. First, we review the academic literature that compares B&M and EC channels regarding their environmental sustainability and identify key factors that

determine the outcome of this comparison. We limit the scientific literature to a comparison of the two channels for non-food retailing to provide a comprehensive overview. Second, we fill the research gap on consumers' perceptions of environmental sustainability by focusing on B&M and EC channels. We present four empirical studies to explore the perceived sustainability of B&M and EC channels. In doing so, we demonstrate that the general assessment of the environmental sustainability of a channel and consumer perception diverge, a finding that constitutes a significant contribution to previous research. Based on a literature review and our empirical studies, we conclude with implications for practitioners and strategies for consumers to better assess the sustainability of distribution channels and to set the right course for improving their sustainability.

2 | COMPARISON OF SUSTAINABILITY IN B&M RETAILING AND EC

Due to the inherent structural differences between B&M retail and EC and the relevance of sustainability for buying decisions, it is crucial to evaluate the environmental sustainability of both channels to identify the advantages and opportunities to make retail more sustainable. B&M retail is defined as "buying and selling conducted in physical stores through physical interactions between customers and salespeople/company/products" (Komiak & Benbasat, 2004, p. 183). In contrast, EC uses "the Internet as a medium for enabling end-to-end business transactions" (Kauffman & Walden, 2001, p. 87), and has become a strong competitor to traditional distribution channels (Carrillo et al., 2014; Schmitz, 2020). EC's growth rate is significantly higher than that of B&M retail, which was further accelerated by COVID-19 (Choi et al., 2019; Feichtinger & Gronalt, 2021).

Several studies that aimed to compare EC and B&M retail channels (e.g., Feichtinger & Gronalt, 2021; Pålsson et al., 2017; Siikavirta et al., 2002) made a valuable contribution by explicitly reviewing and analyzing scientific studies to quantitatively assess the environmental impact of transport activities in EC and B&M retail. Extending their findings, our literature review has a broader focus and considers all factors that are relevant for the involved actors (retailers, consumers, and logistics providers) in both channels. After a literature review of the comparative literature on environmental sustainability in non-food retailing between B&M and EC, our empirical studies also explore consumer perceptions of non-food retailing. The specific factors of environmental sustainability of both distribution channels identified in academic literature are discussed in subsequent chapters.

2.1 | Environmental sustainability from retailer's and consumer's point of view

Sustainability is a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 8). Furthermore, the so-called "triple bottom line," also known as the 3P (planet, people, and profit), divides sustainability into environmental, economic, and social dimensions (Elkington, 1999). In the retail sector, aspects of these three dimensions extend across the entire value chain and retailers need to think about them both backwards and forwards. The idea of a "green value chain" (McCloskey & Smith, 1995; Saha & Darnton, 2005; Sebastianelli & Tamimi, 2020) illustrates the retailer's influence on a sustainable supply chain and his contribution to environmental sustainability in terms of optimizing their processes. Consequently, the environmental perspective has

become an essential part of retailers' annual reports (Kotzab et al., 2011). Rodrigues and Borges (2015) found that consumers do not consider environmental, social, and economic sustainability activities to be of equal value but focus on environmental sustainability. This corroborates the view that sustainability can constitute a competitive advantage for B&M and EC (Simpson et al., 2004; Śmigielska & Oczkowska, 2017).

A key factor that determines the superiority of a particular distribution channel's environmental impact is consumers (Saber & Weber, 2019; Tiwari & Singh, 2011). The way consumers shape their consumption habits, especially in terms of the chosen method of transport or willingness to accept a longer delivery time, has a significant influence on the assessment of CO_2 emissions and the associated sustainability of retail (Bertram & Chi, 2018). A key challenge is consumers' limited capability to determine the environmental impact of both their behavior and available options (e.g., local purchase vs. online purchase), which limits their ability to distinguish environmentally friendly from environmentally harmful shopping behavior (Edwards et al., 2009; Otto et al., 2021). Wiese et al. (2012) also suggest that consumer perceptions of sustainability in B&M and EC differ from objective measurements. Consequently, retailers use various methods (e.g., communication of the environmental impact of certain delivery options) to increase consumers' willingness to accept longer delivery times or use a more efficient delivery method. For instance, Kaur et al. (2021) demonstrated that highlighting the impact of environmentally harmful behavior can lead to a positive, climate-friendly change in consumer behavior. Moreover, incentive systems such as earning points or discounts can influence consumers' consumption habits (Bertram & Chi, 2018; Paul et al., 2016). Consumer decisions made in the after-sale phase, such as the return of products, can cause increases in transport flows (Feichtinger & Gronalt, 2021; Mangiaracina et al., 2016).

Given the substantial influence of consumers on purchase-related processes and their environmental impact, it is essential that consumers become aware of the potential negative consequences of their shopping behavior (Edwards et al., 2010). Nevertheless, research suggests that the overall carbon footprint is not the only driver for shifting from B&M to EC as the supposedly more sustainable of the two channels (Schmitz, 2020).

2.2 | Retail stores, warehouses, and fulfillment centers

Buildings, including retail stores, warehouses, and fulfillment centers, are major drivers of the environmental impact of the retail sector (Saber & Weber, 2019; Van Loon et al., 2015). They are further considered a reason for the emission discrepancy between B&M and EC (Zhao et al., 2019). The environmental impact created by all store activities depends significantly on aspects such as the size of the retailer and its stores (Mangiaracina et al., 2016). Existing research suggests that the environmental impact of buildings depends on the retail sector (product category). For instance, Sivaraman et al. (2007) focused on DVD sales and put buildings in both B&M retail and EC, at less than 5% of the total energy consumption. Retail agglomerations, such as shopping centers, help to further reduce the difference between the channels of B&M and EC, as they create central contact points for consumers and thus lead to economies of scale and a reduction in CO_2 emissions (Matthews et al., 2001; Zhao et al., 2019). In providing a time advantage for consumers, the aggregation of retailers can develop B&M into a high-density channel with positive effects on the environment (Coppel, 2000). Developments such as a reduction in in-stock sizes in B&M stores, a reduction in the number and size of stores, and a stronger integration of EC help to decrease the environmental footprint of the physical environment. (e.g., Cohen, 2000; Tiwari & Singh, 2011).

2.3 | Shopping trips

Consumers' shopping trips are another crucial driver of CO_2 consumption in B&M retail (e.g., Weideli & Cheikhrouhou, 2013; Zhao et al., 2019). Mangiaracina et al. (2016) assumed that 60% of the emissions occur in the pre-purchase and purchase phases, whereas the transport of the consumer itself accounts for the remaining environmental impact of B&M retailing. The CO_2 emissions of an average shopping trip can be higher than those of all upstream logistics activities (Edwards et al., 2010). In terms of environmental impact, a single shopping trip can be compared to a trip by the delivery van of a logistics provider (Cullinane, 2009). While online shopping can reduce shopping trips to a certain extent (Matthews et al., 2001), the growth of EC does not completely substitute shopping trips, as certain products are preferably bought in B&M stores (Edwards et al., 2009; Van Loon et al., 2015).

The environmental impact of shopping trips is context specific and depends on various factors. On a single shopping trip, people usually buy not only individually targeted products; a single shopping trip is a compilation of several points of contact for consumers, which can be combined (Matthews et al., 2001). Consumers should combine their purchases into a single shopping trip, thus reducing the number of trips (Edwards et al., 2009). The option of completing multiple activities within one shopping trip through trip chaining offers the potential to reduce carbon emissions and increase the sustainability of the shopping trip (Edwards et al., 2009; Van Loon et al., 2015). Moreover, the flexible use and combination of different modes of transport by consumers on their shopping trips have an impact on environmental sustainability (Oostendorp & Gebhardt, 2018). COVID-19 has altered consumer shopping behavior. However, environmental sustainability can only be further improved if shopping trips are shifted to online channels, resulting in additional trips using less sustainable modes of transport (Hartwig et al., 2022). Consumers use an intermodal combination in their daily mobility, which is significantly influenced by the availability of public transport and travel to work, with differences between urban and rural areas affecting convenience (Oostendorp & Gebhardt, 2018). The continuing trend toward online shopping (Cohen, 2000; Ladhari et al., 2019) also reduces the number of shopping trips and leads to a reduction in emissions generated by individual trips (Carrillo et al., 2014; Matthews et al., 2001). The growth in online shopping influences trip chaining, which is affected by the channels offered. Online shopping can eliminate shopping trips as they are no longer convenient without visiting shopping destinations, which subsequently changes or reduces the trip chains to non-shopping destinations (Le et al., 2022).

Big differences between the environmental impact of B&M retail and EC can be traced back to the use of cars for shopping trips (Pålsson et al., 2017). Thus, the use of public transport can help counteract the negative environmental impacts of shopping trips (Cullinane, 2009; Zhao et al., 2019). Furthermore, distance to a particular store affects the environmental footprint. Hence, the availability of shops within walking distance can also be positive and reduce traffic (Cohen, 2000; Edwards et al., 2009). The advent of omni-channel retail has influenced the number and extent of shopping trips and their environmental impact. For instance, clicking and collecting may help save natural resources, as it is considered more environmentally friendly than taking advice locally and ordering online for reasons of convenience (Cullinane, 2009). Furthermore, availability checks reduce unnecessary shopping trips resulting from out-of-stock situations (Edwards et al., 2009).

2.4 | Place of residence

Regarding the environmental aspect, consumers' place of residence determines both their access to B&M stores and the processes, costs, and environmental friendliness of EC logistics. Overall, rural regions have a greater environmental impact than urban regions because of difficult logistical structures and less dense populations (Zhao et al., 2017). Wiese et al. (2012) further pointed out that B&M retailing is more environmentally friendly when the distance to the retail shop, and thus the travel route, is short. B&M retail thus can have an environmental advantage in more urban environments (Weideli & Cheikhrouhou, 2013). In contrast, in rural areas, EC has an environmental advantage over B&M stores because of the large distances between B&M stores and consumers (Edwards et al., 2009; Huang, 2017).

Carling et al. (2015) conducted a study of B&M and EC shopping behavior in Sweden and demonstrated that for electronic products, the distance of the consumer to a pick-up point for online orders is regularly shorter than the distance to the closest B&M retailer. Therefore, emissions induced by consumers' transport are 86% lower for EC than for the B&M channel if there is a well-developed network of delivery points (Carling et al., 2015). Furthermore, the place of residence, and thus the distance to possible pick-up points or B&M stores, varies in different countries and depends on the overall infrastructure. Consequently, in more rural regions, where distances to the retailer are longer, consumers predominantly have to use cars for their shopping trips, thus making the trips more harmful to the environment (Feichtinger & Gronalt, 2021). In contrast, the option to take a bus or even walk to a retail shop reduces CO_2 emissions and improves the environmental footprint of B&M retail shops (Sivaraman et al., 2007; Wiese et al., 2012). More specifically, a study by Mangiaracina et al. (2016) showed that in cases where the consumer's home is located directly in the city center or where distances to the nearest retailer are less than 1 km, the CO_2 emissions produced by the consumer's transport for shopping in a B&M store and EC are comparable. However, the authors also find that the farther away the consumer lives from the shop, the larger the environmental advantage of EC is (Mangiaracina et al., 2016).

2.5 | Bundling orders and joint dispatching

In addition to logistical conditions and infrastructure, consumer purchasing behavior is a major determinant of sustainability. Edwards et al. (2009) found that EC has an advantage over B&M in terms of CO_2 emissions. This is true if consumers are traveling by car, purchase fewer than 24 products per average shopping trip, or if consumers traveling by bus buy fewer than seven products (Edwards et al., 2009, 2010). In addition to the opportunity in the B&M channel, in EC, consumers can similarly choose the option of bundling products or whole orders into a single purchase and increasing the basket size to make purchases more environmentally friendly (Cullinane, 2009; Weideli & Cheikhrouhou, 2013). In general, the number of items per order in EC is much lower than in B&M retailing (Van Loon et al., 2015). Thus, increasing the number of products per order is considered a means of changing the environmental sustainability of B&M stores and EC (Edwards et al., 2009; Feichtinger & Gronalt, 2021). Therefore, retailers can consciously use order bundling to save packaging material costs and reduce CO_2 emissions (Muñoz-Villamizar et al., 2021). More efficient order consolidation in the delivery process for EC by the logistics provider may help compensate for the larger shopping carts in B&M retail (Feichtinger & Gronalt, 2021). However, these efforts are set against consumers' demand for

short delivery times that limit retailers' opportunities for efficient and environmentally friendly order consolidation and last-mile logistics (Buldeo Rai et al., 2019).

2.6 | Returns and return management

In addition to the size of the shopping basket, return behavior is an important consumer-related determinant of the sustainability of distribution channels (Edwards et al., 2010). In EC, returns are a significant issue that causes an increase in CO_2 (Edwards et al., 2009, 2010) and energy consumption (Pålsson et al., 2017). Nevertheless, consumers expect free returns (Rausch et al., 2021). Return rates vary between product categories and are much higher in EC than in B&M retail (e.g., Schmitz, 2020). Particularly for clothing, people often order several types or sizes, knowing that they will not keep them all (Cullinane, 2009; Edwards et al., 2009). On average, the return rates in EC are approximately 36% to 53%, which are even higher in certain product categories (e.g., clothing and footwear) (Postnord, 2019). However, the return rate heavily depends on individual behaviors and varies between consumer groups (Mangiaracina et al., 2016). Comparing EC and B&M stores, and assuming return rates of 30% to 35% for EC and 10% or less for B&M retail, previous research on product returns considers B&M retail as more beneficial in terms of carbon footprint (Li et al., 2019; Wiese et al., 2012). This finding particularly applies to short distances to the shop (Wiese et al., 2012).

Measures such as picking up returns on the way back from a parcel delivery or returning the product in a B&M shop may help make returns more environmentally friendly (Edwards et al., 2011). Moreover, combining B&M and EC in an omni-channel strategy can mitigate the environmental impact (Zhang & Choi, 2021). However, the most sustainable way would be to avoid returns. Therefore, online shops increasingly implement incentives and measures to avoid orders of different sizes (e.g., by providing detailed product information or indicating the environmental impact of returns in the checkout process) (Röllecke et al., 2018). For B&M retail, research further shows that consumers are willing to travel longer distances to get to their preferred store when buying clothes to avoid "wrong purchases" (Wiese et al., 2012).

2.7 | Packaging

A distinction must be made between primary packaging (packaging of the individual product) and transport-related packaging (packaging used in EC for the delivery of the product or the order) (Van Loon et al., 2015). The transport-related individual packaging of EC orders has a major environmental impact (Sivaraman et al., 2007; Tiwari & Singh, 2011). Many researchers consider it to be the strongest driver of carbon emissions and thus an obstacle to the environmental sustainability of EC (e.g., Weideli & Cheikhrouhou, 2013; Zhao et al., 2019). For instance, Van Loon et al. (2015) found that packaging is responsible for approximately one-fourth of the overall EC emissions, whereas it plays a minor role in B&M. This substantiates previous findings by Sivaraman et al. (2007), who estimated that packaging in EC was responsible for 67% of the differences between the environmental impacts of EC and B&M. Beyond objective measures of its environmental impact, packaging in EC has also been shown to influence consumers' perception of the environmental friendliness of EC, as non-recyclable packaging or packaging that is too large reduces the perceived environmental sustainability of online purchases (Bertram & Chi, 2018). Reusable packaging services for EC have recently been tested

and rolled out to reduce the negative environmental impact of packaging (Sundqvist-Andberg & Åkerman, 2021). While the effectiveness of reusable packaging strongly depends on how often reusable containers are used (Greenwood et al., 2021), research demonstrates that the use of reusable packaging systems in retail and logistics positively influences the consumer's perception of sustainability (Rausch et al., 2021).

2.8 | Transport, logistics, and last-mile delivery

Many different components of the supply chain, including production, warehousing, and transport, affect environmental sustainability (Abukhader & Jönson, 2003; Mefford, 2011). According to Mangiaracina et al. (2016), logistics accounts for the largest impact of environmentally harmful carbon emissions in B&M and EC. While the B&M retail and EC supply chains largely follow a similar structure, major differences occur in the distribution phase (Bertram & Chi, 2018). Therefore, many studies have examined the last mile, which covers actual delivery to the consumer and its environmental impact on B&M and EC (e.g., Schmitz, 2020; Siragusa & Tumino, 2021). This is the step in the supply chain that is most visible to customers, and it also has high energy-saving potential that needs to be exploited (Edwards et al., 2009). If consumers handle this step by themselves by picking up their purchases at a B&M store, or if a parcel delivery service delivers online purchases, the last mile has a significant negative impact on the carbon footprint (Feichtinger & Gronalt, 2021). In this case, home delivery by service providers is therefore widely considered a more environmentally friendly option, superior to individual journeys by consumers in B&M retail (Carling et al., 2015; Edwards et al., 2010, and chapter on shopping trips in this research). For instance, Carling et al. (2015) found that the purchase of a product in a B&M store causes 7.4 kg CO_2, while the purchase of a product in EC produces merely 1.2 kg CO_2 along the supply chain, which represents an 84% reduction in CO_2 emissions for EC purchases. Assuming that a delivery attempt is successful and the products of the online order are not returned, an environmentally superior advantage of EC can be expected, predominantly in the non-food sector based on its characteristics (Edwards et al., 2009). This also applies to air transport (Tiwari & Singh, 2011). Multimodal delivery on the last mile, where the possibility of using different vehicle types and options is increased (Bayliss et al., 2022), is also a possibility in the consideration of environmental sustainability in both channels. The multimodal design according to the time-differentiated customer demand and delivery services can be particularly advantageous in the integration of the two channels (Janjevic et al., 2021), offering potential savings of financial and environmental magnitude (Bayliss et al., 2022).

However, faster delivery methods, such as overnight express or same-day delivery, may negatively influence the sustainability of EC. Researchers stand divided on whether this might cause EC to lose its environmental superiority over individual shopping trips (e.g., Bertram & Chi, 2018; Weideli & Cheikhrouhou, 2013). Therefore, retailers may make their consumers aware of the negative consequences of their behavior (e.g., the decision for a faster delivery option) (Weideli & Cheikhrouhou, 2013). Furthermore, providing the consumer with a precise delivery time and updates on it could help reduce the number of failed delivery attempts, resultantly reducing CO_2 emissions (Bertram & Chi, 2018; Cullinane, 2009; Edwards et al., 2009). While researchers argue that a more specific delivery window is accompanied by higher costs for the logistics company (Cullinane, 2009), recent digitalization may improve this issue and enable quick and cheap communication with the customer regarding delivery times and options.

EC is generally considered to have an advantage in terms of the carbon footprint concerning suppliers, delivery, and ordering (Wiese et al., 2012). According to Mangiaracina et al. (2016), EC delivery generates approximately 1 kg of CO_2 compared with 1.5 kg of CO_2 in B&M retailing. This environmental advantage of EC on the last-mile leg of the journey is partly confirmed by Schmitz (2020), who notes that EC is only superior to B&M retail in terms of environmental impact when goods are not directly sent from the manufacturer to a retail shop. Moreover, environmental sustainability significantly depends on the delivery method and use of transport vehicles (Sivaraman et al., 2007).

2.9 | Dual-channel and omni-channel strategies

With the advent of omni-channel retailing, many retailers use a combination of both sales channels, which are sometimes highly integrated and sometimes merely coexist (Verhoef et al., 2015). Varied consumer needs can be met by combining online and offline channels (Zhang & Choi, 2021). Depending on consumers' attitudes toward environmental sustainability, a dual- or omni-channel strategy can constitute a decisive competitive factor for retailers (Carrillo et al., 2014). In addition to profitability, retailers may generate a positive environmental contribution (Zhao et al., 2017). Depending on a particular situation or context, consumers can selectively use a specific channel and thereby consider environmental aspects (Edwards et al., 2009, 2011). However, dual-channel strategies do not automatically lead to advantages, as consumers negatively influence carbon emissions by not using both reasonably (He et al., 2016). A joint strategy that considers environmental aspects must be developed to improve environmental sustainability in an omni-channel setting, explaining the benefits to customers (Pålsson et al., 2017; Zhang & Choi, 2021). Concepts such as showrooming, where consumers visit B&M stores to get inspiration and advice and to experience the haptics of products but order the products online later, can positively impact environmental sustainability, when public transport is used instead of individual vehicles, because no goods are moved (Cullinane, 2009; Pålsson et al., 2017; Rapp et al., 2015). New possibilities such as clicking and collecting, where the customer orders goods online and can pick them up in the B&M store (Beck & Rygl, 2015), and ship-from-store (Bayram & Cesaret, 2021), can offer advantages for retailers, customers, and the environment when used effectively.

2.10 | Summary and research gap

Summarizing the existing research that compares the environmental sustainability of both channels, B&M and EC, we identified various factors that determine the environmental impact of each channel, including consumer behavior, buildings, shopping trips, place of residence, bundling of orders and joint dispatching, returns, packaging, transport and logistics, supply chain-related aspects, and omni-channel functions (see Table 1).

While the presented papers highlight that EC tends to make a more positive contribution to environmental sustainability than B&M, this tendency is regularly subject to various specific conditions and restrictions (e.g., mode of transport, vehicles used, trip chaining, basket size, return rates, distances, and last-mile delivery). The importance of individual-identified drivers may vary depending on the specific sector. The possibilities offered by shopping in the B&M or EC channels with the help of the vehicles used and the possibility of trip chaining limit the

TABLE 1 Factors of environmental sustainability in B&M retail and EC.

	Factors of environmental sustainability								
Authors	**Environmentally conscious consumer behavior**	**Buildings**	**Shopping trips**	**Place of residence**	**Bundling orders and joint dispatching**	**Returns**	**Packaging**	**Transport, logistics, and supply chain**	**Dual-channel and omni-channel strategies**
Bertram & Chi, 2018	x		x			x	x	x	
Carling et al., 2015			x	x				x	
Carrillo et al., 2014	x								x
Cohen, 2000			x				x	x	
Cullinane, 2009			x			x		x	x
Edwards et al., 2010	x		x	x	x	x		x	
Mangiaracina et al., 2016	x	x	x	x		x	x	x	
Matthews et al., 2001			x	x			x	x	
Pålsson et al., 2017		x	x			x	x	x	x
Schmitz, 2020	x							x	
Sivaraman et al., 2007		x	x				x	x	
Van Loon et al., 2015	x	x	x		x	x	x	x	
Weideli & Cheikhrouhou, 2013		x	x	x	x		x	x	
Wiese et al., 2012			x	x		x		x	
Zhao et al., 2019		x	x			x	x	x	
Count	**6**	**6**	**13**	**6**	**3**	**8**	**9**	**14**	**3**

clear allocation of environmentally friendly and environmentally harmful channels. Moreover, omni-channel strategies and phenomena, such as showrooming, provide the opportunity to balance the weaknesses of each channel with the advantages of the other, thus contributing to a more sustainable and environmentally friendly shopping experience (Pålsson et al., 2017). Transport can also be handled efficiently with low carbon emissions via the EC channel; thus, travel by private car is no longer necessary. Furthermore, the warehousing costs for the B&M channel are reduced, and store areas can be more customer-friendly and increasingly focused on the product choice process.

Consumers' perceptions of the sustainability of each channel are more important than objective assessment for a better understanding of consumers' choice of a specific channel and the impact of the environmental sustainability of a particular channel on this decision (Bertram & Chi, 2018; Guillen-Royo, 2019; Tiwari & Singh, 2011; Zhang & Choi, 2021). In particular, consumers who are extremely willing to act responsibly (Rausch et al., 2021) are likely to consider perceived channel sustainability in their decision between B&M and EC (Edwards et al., 2009). Considering the lack of research on consumer perspectives on the sustainability of B&M and EC, we present empirical research extending the above-described objective, mostly CO_2-based findings. Empirical studies complement the comparative literature and provide an overview of both channel assessments. The problem of the varying influence of drivers in the respective channels, as well as drivers that are difficult to assess for consumers, can thus be filtered in an initial evaluation.

3 | EMPIRICAL STUDIES

3.1 | Methodological approach and measures

To analyze consumer perceptions of sustainability in the B&M and EC channels, four separate studies were conducted to examine the environmental dimension of sustainability and its assessment by German consumers in a comparison of B&M and EC. Respondents answered four self-administered online surveys on environmental sustainability in non-food retailing. For the German non-food sector, the online market share is currently 21% (IFH, 2022). The aim of using four studies was to confirm the consistency of the findings across multiple time points and samples and to rule out possible effects of the COVID-19 pandemic.

Several academic publications in the area of retailing have measured environmental sustainability, including aspects such as resources, production, energy saving, and recycling (Björklund et al., 2016; Hill & Lee, 2012; Kim et al., 2015; Miller & Merrilees, 2013; Youn et al., 2017). In line with these publications, we draw on established scales and measure crucial facets of environmental sustainability (e.g., emissions, waste management, recycling, and environmental friendliness) (see Table 3). This global empirical approach was chosen because comparability was to be achieved despite differences between the two channels.

In Study 1, we adapted seven items relating to environmental sustainability (Items 1–7) from Öberseder et al. (2014). The items used in Study 2 (Items 8–13) were adapted from Alvarado-Herrera et al. (2017). In Studies 3 and 4, four items (Items 14–17 and 20–23) were adapted from the scale of Hamari et al. (2016). Moreover, a separate item for a general sustainability question was integrated, and a question directly asking for CO_2 production by EC in comparison with B&M retail was included. All items in the studies (see Table 3) were measured on a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree).

3.2 | Data collection and samples

Studies 1 and 2 use convenience samples as respondents (mainly students) were invited by email and social media to participate in a self-response online survey (snowball sampling). Studies 3 and 4 use data from online access panels operated by a professional market research institute to confirm the reliability of our results for the overall population of adult German consumers as far as possible. Study 3 (conducted in March 2021) and Study 4 (conducted in August 2022) also helped ensure the stability of findings during and after the outbreak of COVID-19 and corresponding changes in shopping behavior and channel choice (Akhtar et al., 2020; Roggeveen & Sethuraman, 2020). Table 2 provides an overview of the descriptive data for all four surveys. Studies 3 and 4 showed no significant differences in terms of sociodemographic age (t-value $= -0.341$, $p = 0.73$), educational attainment (Chi-square $= 3.927$, $p = 0.14$), income status (Chi-square $= 3.359$, $p = 0.19$), or rural or urban living situation (Chi-square $= 0.303$, $p = 0.58$). Study 3 differed significantly from Study 4 only for gender, with a larger number of women (Chi-square $= 11.748$, $p < 0.01$). Thus, the comparability of the two studies is provided.

3.3 | Data analysis and results

All four studies were evaluated using descriptive analyses and comparing the means in terms of distribution channels considering the two groups (B&M vs. EC) in the form of independent t-tests. Table 3 provides an overview of the study's empirical findings.

TABLE 2 Survey overview.

		Study 1	Study 2	Study 3	Study 4
Respondents (N)		212	458	701	601
Time of data collection		December 2019	January 2020	March 2021	August 2022
Data collection		Convenience sample	Convenience sample	Online access panel	Online access panel
Age (mean)		26.3	30.6	50.3	50.6
Gender	Male	40.6%	36.2%	42.7%	52.1%
	Female	59.4%	63.3%	57.2%	47.7%
	Diverse	-	0.4%	0.1%	0.2%
Education	No school education	0.5%	0.4%	0.4%	0.6%
	High school diploma (abitur) or below	45.5%	42.4%	66.5%	71.2%
	B.Sc./M.Sc. degree or above	54%	57.2%	33.1%	28.2%
Income	0–400 EUR	24.7%	17.5%	4.4%	2.5%
	401–2000 EUR	61.4%	56.8%	38.1%	37.4%
	>2000 EUR	13.9%	25.7%	57.5%	60.1%
Place of residence	Urban	/	/	62.7%	61.2%
	Rural	/	/	37.3%	38.8%

The results of Study 1 suggest that B&M is considered more environmentally friendly than EC in terms of reducing the amount of energy consumed or even CO_2 emissions, where the largest mean difference can be found. Furthermore, consumers consider B&M to be significantly more eco-friendly than EC in terms of waste avoidance. With respect to the correct disposal of waste, there is a significant mean difference in favor of B&M compared to the EC channel. When considering recycling activities, the trend continues in that EC has a significantly lower mean value than B&M. Consumers also assume that B&M channels apply environmental protection standards that are higher than legal restrictions, whereby B&M is perceived to be significantly more positive than EC. Only in the orientation to the future do consumers agree that both the B&M and EC channels invest in research and development to protect the environment, as there is no significant difference in the mean values here. For the remaining items measuring environmental sustainability, the respondents in Study 1 consistently ranked B&M as more environmentally friendly and action-oriented than EC. This is indicated by the significant differences in the mean values.

The findings of Study 2, which was a follow-up study to Study 1, reveal that B&M is perceived significantly more positively than EC in terms of all facets of environmental sustainability in Study 2. Engagement in environmentally friendly programs and the implementation of emission reduction are perceived more positively by the B&M channel. Respondents further saw significant differences regarding the responsible use of resources and the use of only the necessary resources. The willingness to protect the environment is also subject to a significant mean difference between the B&M and EC. Finally, Study 2 corroborates the findings from Study 1 regarding the perceived willingness to recycle, as respondents attest to the B&M channel being better at recycling waste products than EC.

Overall, the findings of Studies 1 and 2 clearly show that consumers evaluate the environmental sustainability of the distribution channel significantly more positively for B&M than for EC. Similar to Studies 1 and 2, respondents were again asked in Studies 3 and 4 about the environmental dimension of sustainability for B&M and EC. Overall, the results corroborate the findings of Studies 1 and 2 and demonstrate that for B&M retailing, all items scored significantly higher than for EC. In particular, B&M is perceived as more environmentally friendly and ecologically responsible than EC. Regarding the efficient use of natural resources, there was also a significant mean difference between B&M and EC. Using the B&M channel is perceived as a more sustainable way of shopping than EC. A general assessment of sustainability also supports the B&M channel. These results also confirm that B&M consumes less CO_2 than EC. When considering environmental sustainability at the construct level, there is a significant group difference for all four studies that demonstrate the perceived superiority of B&M from the consumer's perspective (see Table 3). There were no significant mean differences when comparing the two channels (B&M and EC) over the period from Studies 3 to 4. The mean differences for all items in Studies 3 and 4 were below 0.095 (t-values < 1.31, $p > 0.19$). The perception of B&M as a more sustainable channel than EC persists. Means on the construct level for each of the four studies show a trend in favor of B&M concerning the construct of environmental sustainability. The significant p-values ($p < 0.001$) demonstrate that EC is perceived significantly more negatively in terms of environmental factors.

Further analyses addressed the role of age and the COVID-19 pandemic in our research. We therefore integrate previous research that suggests that environmental awareness

TABLE 3 Perceived environmental sustainability of B&M retailing and EC.

Item	B&M retailing		EC		Mean diff.	*t* value	*p*
	M	SD	M	SD			
Study 1:							
1. [Retailers] reduce energy consumption.	3.89	1.244	2.96	1.338	0.929	7.406	<0.001**
2. [Retailers] reduce emissions like CO2.	4.01	1.333	2.64	1.292	1.370	10.730	<0.001**
3. [Retailers] prevent waste.	3.42	1.331	2.33	1.191	1.085	8.846	<0.001**
4. [Retailers] engage in recycling.	4.08	1.166	3.40	1.211	0.675	5.837	<0.001**
5. [Retailers] dispose of waste correctly.	4.52	1.167	3.70	1.153	0.814	7.195	<0.001**
6. [Retailers] corporate environmental protection standards are higher than legal requirements.	3.64	1.230	3.14	1.075	0.495	4.416	<0.001**
7. [Retailers] invest in research and development regarding environmental protection.	3.59	1.278	3.56	1.110	0.031	0.267	0.719
Mean score (items 1–7) for "environmental sustainability"	3.89	0.914	3.11	0.862	0.779	8.940	<0.001**
Study 2:							
8. [Retailers] engage in pro-environmental programs.	4.14	1.069	3.21	1.288	0.922	11.748	<0.001**
9. [Retailers] allocate resources to offer services compatible with the environment.	3.77	1.128	2.97	1.238	0.807	10.309	<0.001**
10. [Retailers] carry out programs to reduce pollution.	3.77	1.186	3.13	1.251	0.647	8.014	<0.001**
11. [Retailers] protect the environment.	3.86	1.140	3.16	1.232	0.698	8.889	<0.001**
12. [Retailers] recycle its waste materials properly.	3.86	1.207	3.02	1.246	0.844	10.383	<0.001**
13. [Retailers] use only necessary natural resources.	3.29	1.247	2.64	1.191	0.652	8.083	<0.001**
Mean score (items 8–13) for "environmental sustainability"	3.78	0.0943	3.02	1.026	0.757	11.543	<0.001**
Study 3:							
14. [Retailers] contribute to saving natural resources.	4.98	1.385	3.52	1.560	1.462	18.551	<0.001**
15. [Retailers] are environmentally friendly.	4.82	1.334	3.35	1.523	1.469	19.197	<0.001**
16. [Retailers] are ecological.	4.71	1.335	3.36	1.544	1.352	17.537	<0.001**
17. [Retailers] are a sustainable mode of consumption.	4.76	1.359	3.43	1.564	1.331	17.000	<0.001**
18. B&M retail produces less CO_2 than EC.	4.96	1.502	3.27	1.627	1.690	20.208	<0.001**

TABLE 3 (Continued)

Item	B&M retailing M	B&M retailing SD	EC M	EC SD	Mean diff.	*t* value	*p*
19. Overall, [retailers] are characterized by a high level of sustainability.	4.65	1.339	3.36	1.507	1.290	16.936	<0.001**
Mean score (items 14–18) for "environmental sustainability"	4.85	1.211	3.38	1.454	1.464	20.461	<0.001**
Study 4:							
20. [Retailers] contribute to saving natural resources.	4.92	1.326	3.64	1.417	1.287	16.243	<0.001**
21. [Retailers] are environmentally friendly.	4.75	1.254	3.5	1.423	1.248	16.113	<0.001**
22. [Retailers] are ecological.	4.67	1.231	3.5	1.401	1.165	15.291	<0.001**
23. [Retailers] are a sustainable mode of consumption.	4.73	1.321	3.49	1.478	1.236	15.277	<0.001**
24. B&M retail produces less CO_2 than EC.	4.88	1.405	3.38	1.498	1.497	17.868	<0.001**
25. Overall, [retailers] are characterized by a high level of sustainability.	4.56	1.269	3.42	1.391	1.140	14.842	<0.001**
Mean score (items 20–24) for "environmental sustainability"	4.79	1.131	3.49	1.3	1.299	18.402	<0.001**

**$p < 0.01$.

increases with consumer age, that is, older people develop a higher interest in sustainability-related issues compared to younger people (Chung et al., 2023; Johnstone & Lindh, 2018; Okada et al., 2019). Moreover, COVID-19 has been found to have increased people's environmental awareness (Ali et al., 2021; Valenzuela-Fernández et al., 2022). Building on these findings, we use eight regression analyses to study the influence of consumers' environmental awareness on the perceived environmental sustainability of both B&M and EC for all our empirical studies (Studies 1 and 2: pre-COVID-19, young respondents; Studies 3 and 4: during/post-COVID-19, older consumers). While our data are not suitable to clearly prove the specific effects of age and COVID-19, the findings suggest stronger positive effects of environmental awareness on perceived environmental sustainability for older consumers and the during/post-COVID-19 data, especially for the B&M channel. For B&M, this is indicated by substantially higher standardized regression coefficients for Study 3 ($\beta_{B\&M} = 0.499$**) and Study 4 ($\beta_{B\&M} = 0.485$**) in comparison to Study 1 ($\beta_{B\&M} = 0.101$) and Study 2 ($\beta_{B\&M} = -0.055$). For EC, we also find more positive effects for older consumers and the during/post-COVID-19 data (Study 3: $\beta_{EC} = 0.036$; Study 4: $\beta_{EC} = 0.082$*) as opposed to Study 1 ($\beta_{EC} = -0.061$) and Study 2 ($\beta_{EC} = -0.132$**). Higher environmental awareness therefore tends to lead to a more positive evaluation of B&M in terms of environmental sustainability, compared to EC.

4 | DISCUSSION AND IMPLICATIONS

4.1 | Discussion

Based on a literature review and four empirical studies, the present research compares the environmental sustainability of the B&M and EC channels and makes several contributions to prior research.

First, we summarize the existing research that aims to compare the environmental aspects of B&M and EC. Therefore, we identify the major factors that influence the environmental impact of both channels and present the key findings of previous research. While neither EC nor B&M is considered dominant in terms of environmental sustainability, most studies consider EC to be more eco-friendly and emphasize its environmental advantage under certain assumptions (e.g., Bertram & Chi, 2018; Carrillo et al., 2014; Edwards et al., 2009, 2010; Feichtinger & Gronalt, 2021; Van Loon et al., 2015; Zhao et al., 2019). However, most of these studies focus on objective measures (e.g., CO_2 emissions), and the consumers' perspectives that influence their channel choice remain unclear.

As a second contribution to prior research, this study closes this research gap by comparing the environmental sustainability of B&M and EC from the customer's perspective. Therefore, consumers' views of the two channels in terms of environmental sustainability (including CO_2 emissions) were assessed at an overall level. Using four separate consecutive studies and various measures of perceived environmental sustainability, we demonstrate that customers perceive B&M as a more environmentally sustainable channel than EC. This is very surprising, as the results contradict the prevailing "objective" assessment of experts presented above (e.g., Bertram & Chi, 2018; Carrillo et al., 2014; Feichtinger & Gronalt, 2021; Zhao et al., 2019).

Third, our findings provide detailed insights into the key factors affecting the perceived environmental sustainability of both retail channels. The results indicate that consumers perceive B&M retailing as superior in terms of recycling management, preventive waste management, energy and CO_2 savings, and efficient resource use. In addition, consumers think that B&M retailers have a stronger willingness to go beyond the legal requirements for environmental protection initiatives than EC retailers. While our research focuses on the environmental component of sustainability, our findings also reveal that consumers perceive B&M to be more sustainable overall. Thus, opportunities for EC in terms of environmental sustainability are not yet perceived by consumers, whose perception of EC may be negatively biased regarding environmental aspects (Escursell et al., 2021).

Fourth, for the period of the COVID-19 pandemic and afterward, no change in the perception of the two channels regarding environmental sustainability can be identified. The evaluations of the two channels were thus consistent, even though the pandemic led to increased use of online channels. Our research further demonstrates that environmental awareness during and after COVID-19 positively influences the evaluation of the environmental sustainability of older consumers for the B&M channel. This indicates that B&M stores may benefit from the ongoing trend toward a higher sustainability awareness among consumers. Moreover, even informed consumers, who perceive themselves as environmentally conscious, do not share the experts' predominantly positive evaluation of EC in terms of CO_2 emissions and believe that shopping in the B&M channel is the more sustainable way of consumption.

To sum up the key findings of our literature review, we can highlight that retailers, consumers, and logistics service providers are the most relevant actors who individually and jointly determine the environmental sustainability of a distribution channel. The main factors

identified in our literature review are retailers' warehouses, retailers' stores, fulfillment centers, transport and logistics, return management, packaging, joint dispatching and the last-mile delivery in retailers' and logistics service providers' spheres of influence, shopping trips, place of residence, and bundling of orders and returns for consumers' sphere of influence (see Figure 1). The main factors determining the environmental impact of B&M or EC distribution are influenced by these actors in varying degrees, and there is also an overlap and lack of clear separation. This means that there are different spheres of influence: Consumers, for instance, decide about the acceptance of inconveniences in terms of delivery times, delivery options, and mode of transport in terms of shopping trips. Trip chaining enables consumers to make their shopping trips more sustainable by reducing carbon emissions. Place of residence is important when it comes to the distance to the respective retailers' store and in relation to the last mile, whose efficiency changes in urban and rural areas. Consumer decision regarding whether orders are bundled or returned in the after-sales stage has an influence on the sustainability of the channel. Consumers who exert their influence close to the end of the supply chain can influence the sustainability of upstream drivers through their choices and purchases or non-purchases. For example, retailers are responsible for store locations and energy management. Relevant buildings such as retail stores, warehouses, or fulfillment centers that are visible to consumers are the responsibility of the retailer, and their carbon footprint contributes to the environmental sustainability of the channel. Logistics handling enabled by this is the responsibility of the retailer and logistics provider. Consequently, return management, packaging, and last-mile delivery are primarily determined by these two actors. Consumers who combine their shopping trips with public transport in the interest of trip chaining and reducing the rate of return make a positive contribution to the environmental balance of the channel. Logistics service providers decide on routing, mode of transport, and CO_2 compensation. Hence, the environmental sustainability of EC or B&M retail is ultimately co-created by the various actors involved in the purchase and distribution processes. However, there are differences in the influence of consumers and how they influence the two distribution channels. In B&M retail, consumers handle the last-mile logistics, whereas in EC, little responsibility lies on the consumers (purchase, selection of predefined delivery options) (Risher et al., 2020). Figure 1 summarizes

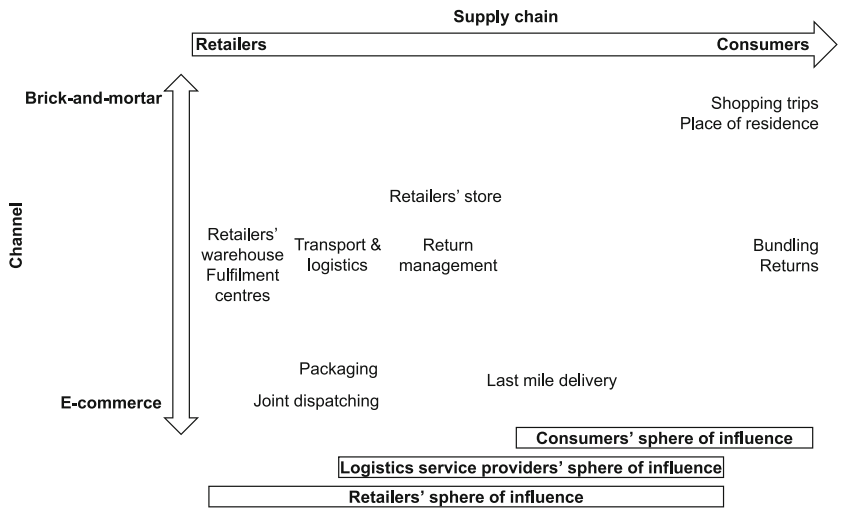

FIGURE 1 Framework of environmental sustainability of brick-and-mortar retailing and e-commerce.

the core factors and actors that influence environmental sustainability and their interrelationships.

In our empirical studies, consumers consistently rated aspects of EC sustainability lower than those of B&M retail. Especially for the items relating to the use of resources and waste avoidance, we find significant differences in consumer perceptions in favor of B&M retailing. Packaging and last-mile delivery constitute major issues for consumers and negatively impact EC's environmental sustainability. The latter is surprising given that previous research shows that consumers' regular shopping trips are more harmful to the environment. According to the self-protective attribution bias (Carver et al., 1980; Davis & Stephan, 1980), an explanation for this difference between perceived and actual sustainability could be that consumers attribute environmentally harmful behaviors to others rather than blame themselves. In other words, consumers consider online retailers or logistics providers responsible for resource consumption from packaging materials and emissions from last-mile delivery to be able to maintain their self-value even though they claim to have a high level of environmental awareness. Conversely, they might evaluate the B&M retail sector more positively in terms of environmental sustainability as they are more involved and have a more active role, especially regarding the last mile (Risher et al., 2020), because they decide when, how often, and how to make shopping trips.

Consumers have a largely passive role in the EC channel, after placing the order and payment, as they have few points of contact until they receive the parcel. This can be illustrated by the role of logistics providers as the only physical touchpoint between retailers and consumers in the last mile (Goebel et al., 2012). Nevertheless, clicking-and-collecting services partially engage consumers in the last mile and lead to stronger customer integration (Halldórsson & Wehner, 2020). Therefore, the intermediate steps of delivery are not clearly transparent from the consumers' perspective. Packaging and last-mile-related issues as crucial drivers of environmental sustainability are most visible to the consumers and more involved in the evaluation process (Edwards et al., 2009; Gevaers et al., 2014). This special focus on the last step before receiving the parcel leads to a negative environmental perception of EC. It is essential to ensure that the last mile in EC is as transparent as possible to make the benefits clear to consumers. This can be achieved on the one hand by expanding the contact points through shipment tracking, feedback features, environmental impact of the current shipment using apps and on the other hand by expanding sustainable delivery options. It is conceivable that consumers do not think that they consume more CO_2 on a B&M shopping trip than ordering online, as they relate the goal of reducing emissions to EC (Thøgersen, 2004). Overall, other actors involved (retailers and logistics providers) are made responsible, and consumers' own contribution to the carbon footprint and environmentally harmful behavior is downplayed or ignored. Thus, our findings are in line with the theory of cognitive dissonance (Festinger, 1962), which has already been applied in the field of sustainable consumer behavior (McDonald et al., 2015; Wu et al., 2018). Thereafter, consumers will avoid information, which increases dissonance and avoids blame for environmentally damaging behavior. A worse evaluation of EC, where consumers play a minor role in factors leading to environmental damage, can dissolve consumer dissonances.

4.2 | Managerial implications

The growing importance of sustainability for consumers and their purchase decisions (Rausch et al., 2021; Sreen et al., 2018) indicates that perceived channel sustainability has the potential to play a significant role in decisions for or against a particular (online) retailer. Therefore, it is

crucial to improve channel sustainability both objectively and in consumer minds. Our findings provide important recommendations for retailers in the B&M sector and online retailers.

Our literature review indicates that B&M retailers should realize that the shops they operate are CO_2-intensive factors and that improvements to infrastructure, such as modern energy-saving buildings and isolation, help to enhance their position in terms of environmental sustainability. The environmental damage resulting from consumers' shopping trips means that B&M retailers are advised to ensure adequate store locations. A better infrastructure that helps consumers get to the shop in a more energy-efficient way (e.g., by public transport) can help improve the sustainability balance. Likewise, it is easier for consumers to combine trips in terms of trip chaining if shops are located close to each other (Edwards et al., 2011) because they can purchase several product groups at one stop, as is the case with shopping centers. In addition to the aggregation of retailers, the possibility of showrooming and using warehouse spaces appropriately in other ways should be seen as a cross-channel strategy. Carbon footprint can be reduced, and more customer satisfaction can be achieved by using both channels in an environmentally friendly manner. This means that strategically appropriate locations must be further developed to reach as many consumers as possible (Carling et al., 2015). Public authorities and cities also play an important role as they are responsible for ensuring good connections in local transport. Transport infrastructure should be improved by considering environmental aspects as logistics is a strong driver of environmental damage in both B&M and EC (Feichtinger & Gronalt, 2021). Sustainable retailing for B&M and EC requires good logistical networking (Zhao et al., 2019). Since consumers have only a limited influence on the fulfillment process, it is up to retailers and logistics providers to cooperate more effectively to save emissions, especially on the last mile. The possible pick-up points in EC should be close to home wherever possible, like B&M stores, to avoid long travel times.

Retailers, in general, need to gain a better understanding of consumers, their behavior, and especially the influence of sustainability on their purchasing decisions. Shopper profiles may help to understand more about consumers' customer journeys and better estimate their shopping frequencies (both B&M and EC), thus allowing retailers to react accordingly (Edwards et al., 2009). For packaging, emission-saving solutions can also be implemented through increased cooperation, which reduces empty runs and saves packaging material, thus reducing waste. If retailers succeed in increasing the number of products purchased per person and decreasing complementary shopping trips, they can catch up with environmental performance (Siragusa & Tumino, 2021; Van Loon et al., 2015). High return rates continue to be a significant driver of the carbon footprint of EC. Therefore, stronger integration of EC and B&M retail can help reduce emissions. Combining the advantages of both EC and B&M retail to provide consumers with large assortments, better advice, and the haptic experience of products can help avoid returns and unnecessary travel. By integrating these channels, customer touch points can be increased, resulting in higher customer satisfaction and repurchase intention, thus improving the economic component of sustainability (Chen et al., 2018). This can also reduce the amount of stock held by B&M retailers and realize the advantages of creating a better and more environmentally friendly retail ecosystem. Moreover, trends such as showrooming can be useful because they enable consumers to perceive city centers more as meeting points while engaging in shopping experiences, and they offer the option to order products locally in the connected online shop (Schneider & Zielke, 2020).

While retailers make significant investments in sustainability (Vadakkepatt et al., 2021), moderate mean scores for B&M retail and EC's perceived investments in research and development regarding environmental protection indicate that consumers still believe that there is

potential for improvement. Therefore, retailers and delivery service providers are advised to strengthen external communication with customers to make them aware of existing environmental efforts (Ignat & Chankov, 2020; Loussaïef et al., 2014), to strengthen the perceived image of the retailer and the market position (Claro et al., 2013).

Especially, online retailers are advised to improve customer communication and emphasize their sustainability, highlighting their beneficial role in terms of environmental sustainability. Therefore, sustainability should be a core component of marketing and key ratios (Sivaraman et al., 2007), data can be communicated more strongly in public, and transparency on company websites is a good option to better inform consumers about activities concerning their carbon footprint (Loussaïef et al., 2014; Paul et al., 2016). Better and more transparent information enables consumers to improve comparisons between retail channels and their perceived sustainability and allows them to make better-informed decisions (Ignat & Chankov, 2020; Saber & Weber, 2019). Relevant information regarding companies' and customers' environmental impact during the distribution phase (e.g., using loyalty cards or app-based solutions) might help foster environmentally friendly consumer decisions. Consumer empowerment (e.g., in terms of bundling orders, packaging, the choice of pick-up points and stores, and returns) and making customers aware of their potential contribution to sustainability in retailing, might further help to improve the sustainability of distribution.

4.3 | Limitations and future research

There are some limitations and suggestions for future research on sustainability in B&M and EC. The findings of the literature review indicate that the environmental sustainability of distribution channels depends on various conditions and is context-specific. While we conducted four consecutive studies on EC and B&M retail, these studies are limited to one country and take a generic perspective on non-food shopping rather than focusing on specific product categories.

Our research findings provide starting points for further research that needs to be conducted for a channel-specific analysis of the factors influencing environmental sustainability from a consumer perspective. A different consideration of specific sectors can also help draw a clear picture that complements our initial findings, which are based on the distinction at the channel level. This analysis can consider the strength of the influence of the identified factors and relevant stakeholders, providing insights for concrete case studies. Moreover, innovations and improvements in processes, logistics, and infrastructure have led to dynamics that might alter the situation in the future (Tiwari & Singh, 2011). Furthermore, the infrastructure in the logistics sector varies from one country to another and cannot be generalized for the whole world based on one country.

On the other hand, consumer behavior plays an important role. It can reverse the sustainability of the two distribution channels so that the advantages of EC can have a lesser impact if purchasing behavior changes significantly. Concerning this, it would be useful to shed light on the identified factors, determining the contradiction between the objective and consumers' views. The future development of environmental awareness in society and the underlying effects on consumers' perception and behavior, differentiated by channel, is up for further research. A concrete investigation of environmental sustainability per channel based on the contribution of the respective drivers requires specific studies where more concretely described scenarios are necessary to enable consumers to make a more specific assessment in a

meaningful way. Further research could more specifically consider all relevant actors, such as consumers, retailers (B&M and EC), logistics providers, public transport, and politics, to make a more concrete statement about sustainability and identify further optimization possibilities to make retailing more environmentally friendly. Finally, with omni-channel retailing and the increasing integration of EC and B&M, it is important to look at EC and B&M in isolation and explore how the combination of both sales channels can work more closely together. Awareness of the benefits of each channel can facilitate an omni-channel structure that can be built and used to improve environmental sustainability and shape a better world with the support of the involved stakeholders.

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