SHEDDING SOME LIGHT ON THE REVERSE PART OF E-COMMERCE: A SYSTEMATIC LOOK INTO THE BLACK BOX OF CONSUMER RETURNS IN GERMANY

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ABSTRACT

In recent years, significant sales have shifted from stationary retail to the internet, which has resulted in the enormous growth of e-commerce. Nevertheless, there is one critical aspect that threatens the success of the business model, namely, consumer returns. While the amount of research on this topic has increased noticeably over the last few years, little is known about the extent of returns and their economic and ecological consequences, as well as about changes over time. Against this background, this paper presents the results of a long-term trend study conducted among German e-tailers from various product group clusters. With an annual turnover of more than $80 billion in 2019, Germany is the sixth-largest business-to-consumer e-commerce market. The study shows that consumer returns are a massive challenge for e-tailers that should not be underestimated. This research adds knowledge about the reverse part of the e-commerce business model. For businesses, the collected data can be used for benchmarking purposes and can help to improve e-tailers' decision-making systems. Societally, this study provides a basis for the quantification of the environmental impact of returns.

Keywords*: E-commerce, Consumer Returns, Return Rates, Return Costs, Ecological Impact*

1. INTRODUCTION

Despite a promising outlook with double-digit growth rates ahead (Lipsman, 2019, Torry, 2020), the e-commerce business model faces a number of challenges along its growth path. Among them are consumer returns. To create trust and to encourage consumers to order, companies are granting liberal return policies, which in turn lead to more online returns than those experienced by traditional brick-and-mortar retailing (e.g., Tarn et al., 2003, Giménez and Lourenço, 2008, Xia and Zhang, 2010). Since the costs caused by returns do not rise linearly, but instead rise disproportionately with the return rate, returns management is considered a critical success factor (Asdecker, 2015). Similar to that seen in brick-and-mortar retailing (e.g., Cassill, 1998), the return process can generate customer satisfaction and loyalty in online retailing (Vakulenko et al., 2019). Due to the importance of returns, it is not surprising that the number of available publications on this topic has risen steadily over the past years. Despite the increased recent attention among scholars, comparatively little is known about the extent of consumer returns in e-commerce or about important key performance indicators; this is in part because many firms consider such information to be confidential (Stock and Mulki, 2009). However, such data are necessary for many reasons, for example, to substantiate the relevance of the underlying research, to better prepare decision-making, to make realistic assumptions for parameter values in quantitative and simulation models, and to provide some estimates of the ecological impact of returns.

Against this background, one of the most frequently cited academic works in the context of returns management is the study by Rogers and Tibben-Lembke (1998). However, this reference is rather dated and refers to the predecessor of e-commerce, namely, catalog retailing. The more recent studies with a scientific background are either much less extensive (e.g., Stock and Mulki, 2009, Bernon et al., 2016) or are based on data from a single e-tailer (e.g., Walsh and Möhring, 2017, Araújo et al., 2018). The only other data points are practitioner-related publications. However, such publications have not been subject to a peer-review process and their methodological approach is often neither transparent nor replicable. Thus, it is of great importance to shed further light on the black box of consumer returns. In particular, this study aims to contribute to the following two research questions:

1 - What is the extent of returns in e-commerce (e.g., return rates) and how are firms performing (e.g., costs)?
2 How do the most relevant key performance indicators change over time?

To answer these questions, we use a longitudinal trend study. To contribute to the theoretical background, this research provides a thorough literature review on returns management key performance indicators and collects its own data to provide descriptive statistics on the extent and consequences of consumer returns. These insights add knowledge to the reverse part of the e-commerce business model. In practical application, the collected data can improve e-tailers' decision support systems and can be used as the basis for benchmarking tools. In terms of general knowledge, this study contributes by quantifying the environmental impact of returns. The following paragraph provides a review of the relevant literature, which emphasizes the current research gap.

2. SYSTEMATIC LITERATURE REVIEW

Unlike other more general literature reviews (e.g., Abdulla et al., 2019), this work specifically focuses on publications that provide insights concerning the extent of consumer returns and important performance indicators to reflect the objectives of this paper. More specifically, this review intends to synthesize available studies about (1) return rates, (2) cycle times, (3) costs, and (4) recovery options.

Methodologically, the review follows the guidelines of Denyer and Tranfield (2009), who structure the research process in the following five steps: (1) question formulation; (2) locating studies; (3) study selection and evaluation; (4) analysis and synthesis; and (5) reporting and using the results. The first step refers to the research questions, which are already derived in the introduction. The second step involves selecting the databases and defining the search terms. In that respect, five scientific databases were selected, namely Business Source Ultimate (BS), Science Direct (SD), JSTOR (JS), Web of Science (WS) and EconBiz (EB). To identify a large number of relevant publications, very general search terms were used, which combined 'product returns', 'consumer returns', or 'customer returns' with either 'rate*', 'cost*', 'time*', or 'recovery'. This resulted in 9323 search hits (see Table 1). In the third step, duplicates and studies that refer to 'stock returns' were removed, leaving 846 publications. Thereafter, titles, abstracts, and keywords were scanned to identify potentially relevant studies, which led to a preliminary set of 52 articles that were read in full length. Publications that addressed only brick-and-mortar retailing were excluded. Once confirmed, the references of each relevant article were searched for further publications of interest. In total, the search led to 44 relevant publications. The list of identified references can be found in the digital appendix of this paper.

TABLE 1. INITIAL SEARCH HITS AND FINAL SELECTION

Search term	**BS**	**SD**	**JS**	**WS**	**EB**
('product returns' OR 'consumer returns' OR 'customer returns') + 'rate*'	242	1475	403	119	52
('product returns' OR 'consumer returns' OR 'customer returns') + 'time*'	288	1799	622	193	102
('product returns' OR 'consumer returns' OR 'customer returns') + 'cost*'	452	1566	507	291	94
('product returns' OR 'consumer returns' OR 'customer returns') + 'recovery'	113	689	124	127	65
Combined results without duplicates & without „stock return"	846				
Preliminary set of most relevant articles	52				
Relevant hits + backward search = Final selection	32 + 12 = 44				

In the fourth step, the publications were classified according to their objective. Most notably, only four of the 44 relevant papers have a scientific background and explicitly aim at collecting statistics on the returns management process (Rogers and Tibben-Lembke, 2001, Stock and Mulki, 2009, Bernon et al., 2016, Araújo et al., 2018). Of the remaining 40 papers, 21 are scientific papers with different overall objectives and 19 are reports by practitioners that were published in nonscientific outlets. Furthermore, the results were categorized based on the four relevant fields of interest, that is, return rates, cycle times, costs, and recovery options. The presentation of the results, which is the final fifth step of the review, can be found in

the following paragraphs. The presentation distinguishes between peer-reviewed scientific contributions and nonpeer-reviewed practitioner contributions. The works are arranged chronologically.

Return rates. Of the 44 relevant studies, 40 reported about return rates, of which 22 (55 %) were scientific papers and 18 (45 %) were published in nonscientific outlets. It is important to note that retailers can determine their return rates in different ways, as noted in Asdecker et al. (2017) and Hofmann et al. (2020): (1) the shipment-based return rate, which reflects the logistics perspective and is referred to as the alpha return rate (α), (2) the item-based return rate, which represents the sales perspective and is referred to as the beta return rate (β), and (3) the revenue-based return rate, which shows the financial perspective and is referred to as the gamma return rate (γ). The alpha return rate divides the number of returned shipments by the number of outbound shipments, whereas the beta return rate sets the number of returned items in relation to the number of shipped items. The gamma return rate divides the value of returned items by the value of ordered items. A further classification can be made in terms of the product category under investigation. Table 2 summarizes the published return rates; the appendix contains further details.

TABLE 2. RETURN RATES REPORTED IN THE AVAILABLE LITERATURE

	Scientific papers	**Practitioner reports**
Cross-sectional rates	Rogers and Tibben-Lembke (2001): 6 % [n.s.], Hong and Pavlou (2014): 13 % [n.s.], Abbey et al. (2018): 16 % [γ], Araújo et al. (2018): 3–4 % [γ], Wang and Ansell (2020): 4–40.6 % [n.s.]	Del Franco (2000): 5–7 % [n.s.], Thomas (2001): 5.5–7.2 % [n.s.], Stock (2004): 5.6 % [n.s.], Brohan (2005): <10 % [n.s.], Banjo (2013): 33 % [n.s.], Pur et al. (2013): 13 % [β], Ng and Stevens (2015): 10–15 % [n.s.], Ellis (2017): 33 % [n.s.], Woods (2017): 25–40 % [n.s.], Appriss Retail (2019): 9.6 % [n.s.], Nicola (2019): 30–50 % [n.s.], Jack et al. (2019): 1–75 % [n.s.], EHI Retail Institute (2019b): 20 % [β]
Fashion rates	Rogers et al. (2002): <40 % [n.s.], Mollenkopf et al. (2007): 20–30 % [n.s.], Petersen and Kumar (2010): 16 % [n.s.], Rao et al. (2014): 15 % [β], Bernon et al. (2016): 8.1–38.2 % [γ], Asdecker et al. (2017): 52.1 [β] / 63.3 % [α], Vilar-Zanon et al. (2017): 25 % [n.s.], Walsh and Möhring (2017): 20 % [α], Asdecker and Karl (2018): 59.8 % [α], Difrancesco et al. (2018): 40 % [n.s.], Sahoo et al. (2018): 15–22 % [n.s.], Shang et al. (2019): 7 % [n.s.]	Del Franco (2000): 30 % [n.s.], Thomas (2001): 40 % [n.s.], Catalog Age (2002): 10–40 % [n.s.], Rösch (2011): 50–70 % [n.s.], Pur et al. (2013): 26 % [β], Stevens (2014): 50 % [n.s.], Ng and Stevens (2015): 30 % [n.s.], Pettypiece (2015): 30 % [n.s.], EHI Retail Institute (2019b): 40 % [β]
Entertain-ment	Mollenkopf et al. (2007): 5–20 % [n.s.], Griffis et al. (2012): 2–11 % [n.s.], Minnema et al. (2016): 8.3 % [n.s.], Bernon et al. (2016): 6.4–10.3 % [γ]	Del Franco (2000): 25–35 % [n.s.], Douthit et al. (2011): 11–20 % [n.s.], EHI Retail Institute (2019b): 10 % [β]
Leisure	Mollenkopf et al. (2007): 5–20 % [n.s.], Cui et al. (2020): 5–14 % [n.s.], Hofmann et al. (2020): 5.1 % [β] / 7.7 % [α]	Del Franco (2000): 2–5 % [n.s.], Catalog Age (2002): 5–10 % [n.s.], EHI Retail Institute (2019b): 10–30 % [β]
Interior	Rabinovich et al. (2011): 2 % [n.s.], Bernon et al. (2016): 5.0–12.7 % [γ], Minnema et al. (2016): 10 % [n.s.], Sahoo et al. (2018): 7 % [n.s.]	EHI Retail Institute (2019b): 20 % [β]
Others	Daily needs: Mollenkopf et al. (2007): <5 % [n.s.]	Daily needs: EHI Retail Institute (2019b): <10 % [β]

Legend: [α] = Shipment-based return rate; [β] = Item-based return rate; [γ] = Revenue-based return rate; [n.s.] = Return rate not specified

Return cycle times. The least amount of data are available in terms of cycle times. Only three peer-reviewed and two nonscientific publications out of the 44 relevant studies refer to the time dimension of the return process. Rogers and Tibben-Lembke (2001) find that 42.0 % of returns are processed within one week, and that 85.3 % are processed within one month. According to Stock and Mulki (2009), the time used is divided into receiving (17 % of time), processing (31 %), sorting (26 %), and disposing (26 %). According to Bernon et al. (2016), some retailers operate returns within 24–48 hours because "[…] good performance was considered to be 48 hours from receipt at the processing center to being back in to stock[…]" (p. 596). From a customer's perspective, the process still might appear to take six days due to shipping lags. Two nonscientific publications supplement the above results. Because of high customer pressure, some retailers directly reimburse after the items pass the first inspection (Rösch, 2011). More than two-thirds of the surveyed retailers process returns and refund customers within 48 hours (EHI Retail Institute, 2019b).

Return costs. A few more studies refer to costs. However, the number of publications remains limited (13 of the 44 relevant studies). Among those, three papers are scientific and 10 are practitioner-oriented. Rogers and Tibben-Lembke (2001) estimate that 4 % of a firm's total logistics costs can be attributed to managing product returns. Stock et al. (2006) estimate the processing costs for one item to be approximately $30–$35. Stock and Mulki (2009) note that 11 out of 16 participating retailers can recover more than 76 % of their original cost, while two retailers are not able to recover more than 25 % of their original cost. On the practitioners' end, Thomas (2001) determines average manual processing costs of $32.40. Based on a survey, Brohan (2005) reports that the majority (67.4 %) of companies face processing costs of up to $10. In addition, 20.4 % are in the range of $11–$15, and 12 % come out to more than $15. Douthit et al. (2011) find the handling and disposition costs of returns to account for 2–3 % of sales. The Economist (2013) quantifies the handling costs for returns from $6–$18 per item without considering the potential loss of value, cutting a retailer's profit by up to 50 %. According to Pur et al. (2013), fashion returns can be resold more frequently than others. Furthermore, they note that most returns cost less than 15€ per item (cross-sector average 20€). Fashion returns can entail high discounts of up to 80 % when out of season with even lower earnings for items sold to liquidators (Pettypiece, 2015). According to Ellis (2017), the "[…] expense of processing and shipping […] can range from 20 percent to 65 percent of an e-tailer's cost of goods sold[…]". Woods (2017) interviews an UPS executive who estimates returns processing costs to be 10–15 % of the goods' value. Nicola (2019) notes that shipping is the dominant part of the total return costs (11€), followed by diminished product value, the inspection of returned items, and collecting/identifying them. An EHI Retail Institute (2019b) study reports average processing costs of 10€ per returned item. In addition, large differences exist between product categories, with the lowest costs in fashion (5€) and the highest costs in consumer electronics and DIY (15€).

Recovery options. Out of the 44 relevant studies, nine refer to recovery options, out of which four have been peer-reviewed. Rogers and Tibben-Lembke (2001) report that 17.6 % of returned goods are resold as is, 15.5 % are remanufactured, 14.7 % are recycled, 13.9 % are disposed of as scrap, 11.0 % are repackaged and sold as new, 9.0 % are sent to a central processing facility, 6.8 % are donated, 5.6 % are sold to a third-party broker, and 5.1 % are sold at an outlet store. Stock and Mulki (2009) find that 88.3 % of survey respondents return products directly to inventory, while 81.8 % do either destroy or sell at least some returns as scrap. Other options used are repackaging and inserting into inventory (61.4 %), donating to charity (37.2 %), selling on third-party/secondary markets (19.0 %), and repairing/refurbishing (4.1 %), among other options (19.9 %). The case study by Araújo et al. (2018) states that 70 % of returned items are in a good-as-new condition and are directly returned to retail inventory. Another 5 % are forwarded to the supplier for direct review and technical assistance. The remaining 25 % are sold at a reduced price during a knockdown sale or disposed of as scrap. Hjort et al. (2019) note that most items are returned to the shelf, but all retailers also dispose some as scrap. Only one in 12 retailers donates any returns to charity. The scientific studies are complemented by five practitioner publications. According to Brohan (2005) approximately 39.5 % of e-tailers use auction platforms to sell returns at a discount. Pur et al. (2013) find that 38 % of returns can be directly reinserted into the sales channels, whereas 24 % need repackaging, 16 % need refurbishment, 12 % can only be sold as B-stock, and 10 % cannot be resold again. A supply chain consultant interviewed by Stevens (2014) estimates that 70 % of returned merchandise is suitable for resale. Ng and Stevens (2015) describe that many returns are resold in bulk at only 10–20 % of the original value. Reselling online can lift recovery rates to 40–70 %. Besides, according to an interviewee, up to 20 % of returns cannot be resold due to damages. A recent EHI Retail Institute

(2019b) study reports that 70 % can be resold as new. For the rest, companies refer to secondary markets or third-party brokers (53 %), recycling or disposal (47 %), outlet stores (36 %), donations (28 %), a return to the supplier (25 %), or staff sales (21 %).

This exhaustive literature review shows that the available data on consumer returns are rather limited. The majority of cited publications refer to data from a single company. In addition, the comparison of the different values per category shows a wide range. The greatest consensus is that the fashion segment has the highest return rates. However, it is not possible to draw conclusions about how high these return rates actually are in the overall market. The same applies to the values for return costs, cycle times, and the employed recovery options. In addition, the available studies only report mean values. Standard deviations and confidence intervals are not provided. A study on developments and trends could not be found. Given this high degree of uncertainty, we conclude that a systematic empirical study is needed to address this knowledge gap. For that purpose, this research draws on Germany, which is the largest national market within the European Union (EU). Globally, Germany ranks sixth, with a turnover of $81.85 billion in 2019, following China ($1,934.78 billion), the United States ($586.92 billion), the United Kingdom ($141.93 billion), Japan ($115.40 billion), and South Korea ($103.48 billion) (Lipsman, 2019). The following section provides a more detailed description of the German e-commerce market.

3. E-COMMERCE IN GERMANY

E-commerce companies in Germany are well organized within associations. These include the leading association of e-commerce companies, the “Bundesverband E-Commerce und Versandhandel e. V.” (BEVH), and the association of delivery companies, the “Bundesverband Paket- und Expresslogistik e. V.” (BIEK). Apart from the thus far neglected consumer returns, the BEVH and the BIEK collect and publish various data on e-commerce in Germany, of which the most relevant are presented in the following in a condensed form.

According to the BEVH, the revenue generated in German e-commerce totaled 72.64 billion € in 2019 up from 65.10 billion€ in 2018 (+11.6 %) (BEVH, 2020). At an average exchange rate of $1.120/€ in 2019 (IRS, 2020), this corresponds to $81.36 billion and is very close to the already mentioned estimate by Lipsman (2019). A major share of revenue comes from the product group clusters «Entertainment» and «Fashion» (see Table 3).

TABLE 3. DETAILED ORIGIN OF THE REVENUE GENERATED IN GERMAN E-COMMERCE

Cluster	Associated product categories	Revenue 2019 (%)
Enter-tainment	Books/e-books/audio books, CDs/DVDs, computer/accessories, games/software including downloads, electric goods/telecommunications	25.84 billion € (35.57 %)
Fashion	Clothing, accessories, shoes	18.71 billion € (25.76 %)
Interior	Furniture/lamps/decoration, home textiles, household goods/appliances	10.92 billion € (15.03 %)
Leisure	DIY/flowers, toys, car/motorbike/accessories, hobby/leisure articles	8.66 billion € (11.92 %)
Others	Anything that is be attributed to the other product groups	8.51 billion € (11.72 %)

E-commerce in Germany is characterized by many small and medium-sized merchants who sell their goods in their own shops or via marketplace platforms (e.g., Amazon marketplace, eBay). At the same time, a few online shops concentrate a large share of total revenue. According to the EHI Retail Institute (2019a), the 30 e-tailers with the most revenue account for more than one-third (25.3 billion €; 38.9 %) of the total German e-commerce sales.

The growth in revenue goes hand-in-hand with an increase in the number of parcels transported (BIEK, 2019, BIEK, 2020). In 2019, logistics service providers in Germany transported 3.65 billion courier, express,

and parcel shipments (2018: 3.52 billion shipments). Parcels accounted for 84.2 % (2018: 83.9 %), which led to 3.07 billion parcel shipments (2018: 2.95 billion parcels). Of this figure, 65 % (2018: 62 %) was attributed to the business-to-consumer (B2C) segment, including returns. This equaled 1.99 billion shipments in B2C e-commerce. It increased from 1.83 billion in 2018 and corresponded to a growth rate of 8.7 %. Since the BIEK studies draw on transaction data of the member companies, a high validity and reliability can be assumed. With regard to the distribution of the shipment quantities across the respective product categories, a study on behalf of the BEVH concludes that the share of outbound shipments largely corresponds to the revenue share of the product categories (MRU GmbH, 2014), which is also assumed in the remainder of this paper.

The legal basis for returns in member states of the European Union is the consumer rights directive 2011/83/EU, which has been incorporated into national law. Accordingly, consumers in Germany have the right to revoke a purchase on the internet within 14 days after delivery without providing reasons. In principle, consumers bear the direct costs of returning goods to the retailer unless the retailer voluntarily waives this right or fails to inform the customer about the return costs during the order. Despite the legal possibility, in practice, the vast majority refrain from doing so.

Due to the extensive consumer rights and liberal return policies of the major vendors, which are a de facto standard for the entire German e-commerce market, consumers have generally developed an expectation of customer-friendly policies. This study aims to provide information about the extent of consumer returns. For that purpose, data are collected. This collection process is described in the following paragraph.

4. SURVEY

To improve the available data regarding consumer returns, the authors of this paper designed a longitudinal study to observe the same phenomenon over an extended period. More specifically, a trend study was employed, also referred to as a repeated cross-sectional study, which draws different recurring samples over time from a population that answers the same questionnaire (Babbie, 2005). Consequently, trend studies are "[…] a typical instance of a design that is cross-sectional at the level of the sampling units, but longitudinal at the level of research units" (Taris, 2000, p. 6). It is considered suitable to examine change at the aggregate level (Taris, 2000, Babbie, 2005). Moreover, trend studies are unaffected by panel attrition, e.g., due to job and career changes, which would have made the data collection and analysis considerably more difficult if not completely infeasible.

To support data collection, a website was set up in 2013 (http://www.retourenforschung.de) to provide various information and tools for practitioners (e.g., a review of existing literature, a returns management encyclopedia, a tool for calculating the profit-optimal return rate, and study reports). To gain access, interested individuals had to register for a so-called online expert panel and agree to receive invitations to future studies. Only registrations that used a professional e-mail address and could prove their professional experience in regard to e-commerce returns management were accepted. For this last step, the provided data were counterchecked with information that was found on professional social networks (Xing, LinkedIn) to ensure that the registered had access to the information relevant for such studies. The registered experts were invited to participate in the study, which is described in more detail in the following section.

4.1. Methodology

For data collection, this research used online questionnaires. Unlike their paper-based counterpart, online surveys allow for a variable survey design and the integration of dynamic elements. Beyond that, the targeted participants, who are responsible for returns management at German e-tailers, most likely prefer the internet as a communication medium. The questionnaire was structured into three parts.

Before the actual questionnaire, a virtual cover letter informed the participants about the background of the survey and assures them of anonymity. To increase the motivation to participate, it was pointed out that only participants would receive a full study report after the collected data were analyzed and that a scientific, publicly accessible report would only be made available after a waiting period of at least 18 months. Next, the first part queried essential characteristics of the respondents and asked them to identify the product

category with the largest share of sales. The purpose of this part was (1) to ensure that only professionals from e-commerce or multichannel retailers participated and (2) to be able to refer to a specific product category in later questions. The second part surveyed performance indicators, for example, the return rates and return costs. The final third part asked for the revenue of each company, which was used to assess the representativeness of the sample. Before the initial field phase in 2014, the survey was pretested by six experts with either an academic or an industry background, of which three used the cognitive pretesting method suggested by Krosnick (1999). Based on their remarks, several changes were made with regard to the relevant key performance indicators, wording, and question sequence.

The study used three sample acquisition channels to address potential participants:

- Members of the expert panel: All returns management experts who successfully registered for the online panel (see previous section) at the time of data collection were invited to participate.

- Members of German e-commerce associations: The two largest German associations (BEVH, Händlerbund) drew attention to the study via a dedicated e-mail to their members or via newsletters. The registered association members represent the top management level.

- Professional social networks. The survey invitation was shared in several e-commerce groups on two of the most popular professional social networks, namely, Xing and LinkedIn.

Empirical studies are subject to various potential biases. Although the influence of such biases can never be completely ruled out (MacKenzie and Podsakoff, 2012), procedural precautions were taken to counteract and minimize such effects and increase the validity of the survey. Special attention was given to four biases, namely, (1) method bias, (2) sampling bias, (3) nonresponse bias, and (4) social-desirability bias. Table 4 provides an overview of the employed countermeasures.

To ensure validity, multiple plausibility checks were conducted. For instance, we checked the plausibility of questions 4–6 by comparing the answers. The number of returned shipments (question 5) divided by the number of outbound shipments (question 4) should approximately result in the reported alpha return rate (question 6). In case of inconsistent answers, the participants were excluded. As the questionnaire did not contain any scales, common reliability measures could not be calculated. Nevertheless, the similar results of the two surveys indicated reasonable retest reliability. Furthermore, all results were discussed with and confirmed by industry experts who did not participate in the survey. These experts emphasized that the findings are representative of the German e-commerce market.

After the preparation of the study, data were first collected between September and November 2014. During this period, 270 respondents started the survey of which 143 (53 %) were e-commerce or multichannel merchants who completed it without showing an unusual response behavior. The second data collection period took place between November and December 2018. This time, 143 individuals started the questionnaire, of which 68 (48 %) participants completed the survey. Both samples reflect the diversity of German e-commerce in terms of the most relevant product group clusters (see Table 5). The total e-commerce revenue that was realized by the participants in Germany in the fiscal year preceding their response amounts to 6.1 billion € (2014) and 1.2 billion € (2018). The companies that participated in the survey thus accounted for 15.6 % (2014) and 2.1 % (2018) of the total German e-commerce sales at the respective times (MRU GmbH, 2014, BEVH, 2018).

TABLE 4. BIASES AND COUNTERMEASURES WITHIN THE STUDY

Bias	Definition	Countermeasure
Method bias	Systematic measurement error due to the inability or unwillingness to provide an accurate answer (MacKenzie and Podsakoff, 2012)	• To minimize the lack of a respondent's ability to provide accurate answers (MacKenzie and Podsakoff, 2012), only professionals with the necessary experience in e-commerce returns management were invited to participate in the study. • A pretest was conducted to increase the understandability and decrease the effect of complex and abstract questions (Doty and Glick, 1998; Krosnick, 1999). Examples complement the survey questions to illustrate more complex issues. A maximum of two questions were asked on a questionnaire page to avoid visual cognitive overload (Schmitt, 1994). • The participants were given instructions about the most relevant information in the cover letter to have the opportunity to collect the data before they start the survey (Krosnick, 1999). In addition, they were asked to answer the questions as accurately as possible and were provided with the possibility to move backward in the survey to change their answers. • To increase the motivation of the respondents and reduce potential satisficing (Krosnick and Alwin, 1987), a virtual cover letter explained the purpose of the study and reminded participants how they and their organizations would benefit from the research. • Contexts that aroused suspicions were mitigated by assuring participants of anonymity and that their data would only be used for research purposes (Schmitt, 1994).
Self-selection bias	Systematic measurement error due to a nonrandom sample of the population (Bethlehem, 2010)	• Participation in a study about returns management might be more appealing to companies with high return rates. Therefore, the study invitation email highlighted the need of participation independent of the respective return rate and volume.
Nonresponse bias	Systematic measurement error because of the underrepresentation of certain respondent groups (Berg, 2005)	• To prevent item nonresponse bias this study referred to complete-case analysis. That is, incomplete responses were removed from data analysis (Little and Rubin, 1989). • With regard to general nonresponse, this study opted for a two-sample validation technique (Berg, 2005) that compares two subsamples from the same population.
Social-desirability bias	Systematic measurement error due to overreporting/ underreporting of socially desirable/ undesirable outcomes (Krosnick, 1999)	• This study employed an anonymous online questionnaire, which has a lower risk of social-desirability bias than traditional forms of data collection (Grimm, 2010). • Most of the surveyed data does not relate to the respondents' behavior. Instead, the participants reported on the outcomes of consumer behavior, which reduced the susceptibility to social-desirability bias. An exception is the question about recovery options (in particular the disposal/scrap option). To obtain the most valid data possible, the options were queried in an embedded style instead of single questions.

TABLE 5. SAMPLE CHARACTERISTICS

	Sample 2014	**Sample 2018**
Product group cluster	Fashion (n=54, 37.8 %), Entertainment (n=16, 11.2 %), Leisure (n=32, 22.4 %), Interior (n=16, 11.2 %), Others (n=25, 17.5 %)	Fashion (n=25, 36.8 %), Entertainment (n=10, 14.7 %), Leisure (n=12, 17.6 %), Interior (n=8, 11.8 %), Others (n=13, 19.1 %)

The sharp decline in the number of participants can be attributed to several factors. These factors include that the second survey period coincided with the busy Christmas business season. Furthermore, the support received from the German e-commerce associations was more reserved, in some part because the survey overlapped with other internal studies. In addition, the 2014 survey benefitted from being one of the first returns management studies in Germany. Furthermore, some participation fatigue can be observed. To ensure the validity of the second survey despite the smaller sample size, after data collection, the results were presented to selected members of the expert panel who did not participate in the study. They were asked to compare the results with their internal data and industry experience. In this step, retailers with a broad product range proved to be particularly helpful, as they were able to make assessments for several categories. Overall, they attributed a high degree of representativeness and external validity to the presented results. To further account for a potential nonresponse bias, the mean values of the several variables of dropouts were compared with those who finished the survey. All tests were statistically insignificant at an α=.05 level. Therefore, we are confident that nonresponse is not an issue in this study.
The authors of this study embrace the principles of open science with the overarching goal of increasing the reproducibility and replicability of the study results as well as promoting the collaboration of scholars. For this reason, not only is the questionnaire provided in Appendix 1 of the paper but also the collected data have been made available in an open-access repository. To achieve the desired transparency while respecting the anonymity guaranteed to the survey participants, the companies' revenue figures have been removed, as the presence of this information would allow for an easy identification of some participants. The following section presents the study results.

4.2. Results

Because various other studies (Appriss Retail, 2019, EHI Retail Institute, 2019b, Bernon et al., 2016) suggest that the extent of consumer returns depends on the respective product category, this study refers to the previously introduced clusters (entertainment, fashion, leisure, interior, others). Within the clusters, this analysis uses weights to represent the market as realistically as possible. The weights are calculated based on the provided number of outbound packages (for the return rates), received return packages (for the number of articles per returned shipment), and returned articles (for the remaining key figures) to account for company size and the degree to which a company is affected by returns. To avoid sample inflation, the weights are normalized to the respective original sample size as suggested by Maletta (2007). All calculations and statistical tests were performed in SPSS 26.

After calculating the weighted averages (Ø), standard deviations (SD), and confidence intervals (CI) to answer the first research question, the mean values of the two samples from 2014 (S1) and 2018 (S2) are compared using t-tests to identify changes as referred to in the second research question. The following subsections present the results for the return rates, the number of items per returned shipment, processing times, costs, and recovery options. In the case of significant differences (α<.05), the table fields are printed in italics.

4.2.1. Return rates and number of items per returned shipment

The «Fashion» cluster has by far the highest return rates (see Table 6). With an average alpha return rate of approximately 50 %, half of the packages sent out are later returned. The «Fashion» segment also shows the largest number of items per returned shipment, thereby indicating a high proportion of selection orders where customers order several products for comparison. Despite the often-discussed preventive measures, this study shows that the return rates have hardly changed over time. Only in the «Entertainment» cluster did the alpha return rate decrease significantly ($t(24)=3.124$, $p=.005$). Furthermore, in the «Fashion» cluster, the beta return rate decreased significantly ($t(77)=8.876$, $p<.001$), while the number of items per returned shipment has increased ($t(77)=-5.271$, $p<.001$). These outcomes suggest that fashion e-tailers successfully decreased the return probabilities of individual items by means of preventive measures, e.g., with regard

to fit issues (Bertram and Chi, 2018; Saarijärvi et al., 2017). However, since customers have simultaneously formed larger shopping baskets, this decrease is not reflected in the alpha return rate.

TABLE 6. RETURN RATES STATISTICS AND NUMBER OF ITEMS PER RETURNED SHIPMENT

Cluster	**Alpha return rate** *Sample-ID: Ø, SD, 95 %-CI*	**Beta return rate** *Sample-ID: Ø, SD, 95 %-CI*	**Number of items per returned shipment** *Sample-ID: Ø, SD, 95 %-CI*
Entertain-ment	S1: 8.39 %, 2.19, [7.22, 9.56] S2: 5.38 %, 2.69, [3.45, 7.31]	S1: 5.27 %, 1.76, [4.33, 6.21] S2: 4.97 %, 2.80, [2.97, 6.98]	S1: 1.31, 0.08, [1.27, 1.36] S2: 1.18, 0.38, [0.91, 1.45]
Fashion	S1: 50.20 %, 7.21, [48.24, 52.17] S2: 46.46 %, 13.49, [40.89, 52.03]	S1: 33.98 %, 5.40, [32.51, 35.46] S2: 20.41 %, 6.71, [17.64, 23.18]	S1: 2.06, 0.37, [1.96, 2.16] S2: 3.20, 1.06, [2.77, 3.64]
Interior	S1: 5.68 %, 2.41, [4.40, 6.97] S2: 5.45 %, 1.35, [4.31, 6.58]	S1: 4.65 %, 1.97, [3.60, 5.70] S2: 4.63 %, 1.04, [3.76, 5.50]	S1: 1.07, 0.07, [1.03, 1.10] S2: 1.03, 0.13, [0.92, 1.14]
Leisure	S1: 12.26 %, 11.12, [8.25, 16.26] S2: 10.30 %, 3.04, [8.37, 12.23]	S1: 8.30 %, 8.95, [5.07, 11.53] S2: 8.47 %, 2.69, [6.76, 10.18]	S1: 1.49, 0.45, [1.33, 1.66] S2: 1.57, 0.37, [1.33, 1.80]
Others	S1: 5.33 %, 8.61, [1.78, 8.88] S2: 5.66 %, 8.12, [0.75, 10.57]	S1: 5.19 %, 8.60, [1.64, 8.74] S2: 4.80 %, 2.44, [3.33, 6.28]	S1: 1.02, 0.10, [0.98, 1.06] S2: 1.25, 0.41, [1.01, 1.50]

4.2.2. Cycle time-related performance indicators

In addition to return rates, cycle time-based key figures are an important performance criterion. This research distinguishes between (1) transport time, (2) internal processing time, and (3) reimbursement time (see Table 7). In all product categories, transport times are approximately two days and have remained virtually unchanged in the four years under investigation. With regard to internal processing times, the data collected indicate that many e-tailers have sped up their internal processes, particularly with regard to the «Entertainment» ($t(24)=10.074$, $p<.001$), «Interior» ($t(22)=4.132$, $p<.001$), and «Leisure» ($t(42)=3.425$, $p=.001$) clusters. In addition, the average reimbursement time in the «Entertainment» ($t(24)=5.636$, $p<.001$), «Interior» ($t(22)=5.604$, $p<.001$), and «Others» ($t(36)=3.903$, $p<.001$) clusters has decreased significantly, which benefits customers.

TABLE 7. CYCLE TIME-BASED RETURNS MANAGEMENT PERFORMANCE INDICATORS

Cluster	**Transport time** *Sample-ID: Ø, SD, 95 %-CI*	**Internal processing time** *Sample-ID: Ø, SD, 95 %-CI*	**Reimbursement time** *Sample-ID: Ø, SD, 95 %-CI*
Entertain-ment	S1: 2.08 days, 0.29, [1.92, 2.23] S2: 2.22 days, 0.69, [1.73, 2.72]	S1: 4.48 days, 0.88, [4.01, 4.95] S2: 1.38 days, 0.51, [1.02, 1.75]	S1: 9.15 days, 2.50, [7.81, 10.48] S2: 2.63 days, 3.40, [0.19, 5.06]
Fashion	S1: 2.11 days, 0.40, [2.00, 2.22] S2: 2.24 days, 0.62, [1.98, 2.50]	S1: 2.59 days, 0.76, [2.39, 2.80] S2: 2.50 days, 0.84, [2.16, 2.85]	S1: 5.89 days, 1.86, [5.38, 6.39] S2: 5.14 days, 2.62, [4.06, 6.23]
Interior	S1: 2.49 days, 0.71, [2.12, 2.87] S2: 2.05 days, 0.44, [1.69, 2.42]	S1: 2.13 days, 0.62, [1.81, 2.46] S2: 1.09 days, 0.31, [0.83, 1.34]	S1: 6.89 days, 3.63, [4.96, 8.83] S2: 1.44 days, 1.00, [0.61, 2.28]
Leisure	S1: 2.12 days, 0.74, [1.86, 2.39] S2: 1.95 days, 0.30, [1.76, 2.15]	S1: 4.34 days, 1.61, [3.76, 4.92] S2: 2.70 days, 0.61, [2.31, 3.09]	S1: 4.59 days, 1.67, [3.99, 5.19] S2: 3.96 days, 0.64, [3.56, 4.37]
Others	S1: 2.20 days, 0.82, [1.86, 2.54] S2: 2.57 days, 0.53, [2.25, 2.89]	S1: 1.92 days, 1.59, [1.26, 2.57] S2: 1.88 days, 0.83, [1.38, 2.38]	S1: 8.57 days, 2.15, [7.68, 9.46] S2: 4.99 days, 3.51, [2.86, 7.11]

4.2.3. Return costs

Consumer returns cause costs for transport and processing. The latter explicitly includes costs for remarketing and depreciation due to deterioration in condition. In 2014, it is shown that online fashion retailers realize very low costs per item (see Table 8). The costs are particularly high in the «Entertainment» and «Interior» clusters. The data collected in the survey suggest that efficiency gains have significantly reduced costs, particularly in the «Fashion» (transport costs: $t(77)=6.503$, $p<.001$; processing costs: $t(77)=2.694$, $p=.009$) and «Leisure» (processing costs: $t(42)=7.552$, $p<.001$) segments.

TABLE 8. COSTS PER RETURNED ITEM

Cluster	Transport costs per returned item *Sample-ID: Ø, SD, 95 %-CI*	Processing costs per returned item *Sample-ID: Ø, SD, 95 %-CI*
Entertain-ment	S1: 4.20 €, 1.64, [3.32, 5.07] S2: 4.44 €, 3.46, [1.97, 6.91]	S1: 10.27 €, 8.16, [5.92, 14.62] S2: 10.46 €, 7.19, [5.31, 15.60]
Fashion	S1: 2.30 €, 0.52, [2.16, 2.44] S2: 1.41 €, 0.66, [1.13, 1.68]	S1: 1.65 €, 0.89, [1.41, 1.89] S2: 1.22 €, 0.52, [1.00, 1.43]
Interior	S1: 13.78 €, 13.32, [6.68, 20.88] S2: 23.04 €, 10.19, [14.52, 31.55]	S1: 10.57 €, 5.34, [7.72, 13.41] S2: 11.10 €, 3.71, [7.99, 14.20]
Leisure	S1: 6.10 €, 1.41, [5.59, 6.61] S2: 5.51 €, 1.34, [4.65, 6.36]	S1: 10.66 €, 2.63, [9.71, 11.61] S2: 4.49 €, 1.66, [3.43, 5.54]
Others	S1: 5.28 €, 2.84, [4.11, 6.46] S2: 3.96 €, 1.47, [3.07, 4.85]	S1: 6.17 €, 5.21, [4.02, 8.32] S2: 3.71 €, 1.98, [2.51, 4.91]

4.2.4. Recovery options

Part of the processing costs are due to remarketing or depreciation. It is therefore important to determine which share of returned items can be resold as new. This proportion is very high in the «Fashion» sector and particularly low in the «Entertainment» cluster (see Table 9). Over time, the proportions of the individual recovery options have remained relatively constant.

TABLE 9. EMPLOYED RECOVERY OPTIONS

Cluster	Sold as new *Sample-ID: Ø, SD, 95 %-CI*	Sold as used/returned product *Sample-ID: Ø, SD, 95 %-CI*	Sold to third party broker *Sample-ID: Ø, SD, 95 %-CI*
Entertain-ment	S1: 60.84 %, 7.10, [57.05, 64.62] S2: 64.39 %, 20.90, [49.44, 79.34]	S1: 31.09 %, 7.92, [26.87, 35.31] S2: 26.52 %, 12.55, [17.54, 35.49]	S1: 4.72 %, 6.61, [1.20, 8.24] S2: 7.27 %, 10.94, [-0.56, 15.09]
Fashion	S1: 90.89 %, 6.93, [89.00, 92.78] S2: 94.21 %, 13.38, [88.69, 99.74]	S1: 5,34 %, 4.48, [4.11, 6.56] S2: 2.09 %, 4.22, [0.35, 3.84]	S1: 2.68 %, 3.75, [1.65, 3.70] S2: 1.07 %, 4.13, [-0.63, 2.77]
Interior	S1: 60.11 %, 13.50, [52.92, 67.30] S2: 69.54 %, 24.12, [49.37, 89.71]	S1: 28.17 %, 14.77, [20.30, 36.04] S2: 15.49 %, 5.49, [10.90, 20.08]	S1: 1.61 %, 4.69, [-0.90, 4.11] S2: 6.50 %, 10.65, [-2.41, 15.40]
Leisure	S1: 81.66 %, 13.65, [76.74, 86.58] S2: 79.19 %, 11.18, [72.09, 86.29]	S1: 10.67 %, 5.33, [8.75, 12.59] S2: 11.63 %, 6.43, [7.54, 15.71]	S1: 2.12 %, 7.24, [-0.49, 4.73] S2: 4.34 %, 3.46, [2.14, 6.54]
Others	S1: 86.66 %, 25.65, [76.07, 97.24] S2: 81.21 %, 12.93, [73.40, 89.02]	S1: 7.08 %, 21.20, [-1.67, 15.84] S2: 6.82 %, 8.50, [1.68, 11.95]	S1: 0.05 %, 1.11, [-0.41, 0.51] S2: 1.18 %, 1.40, [0.33, 2.03]
Cluster	**Donated** *Sample: Ø, SD, 95 %-CI*	**Disposal** *Sample: Ø, SD, 95 %-CI*	**Other recovery option** *Sample: Ø, SD, 95 %-CI*
Entertain-ment	S1: 0.01 %, 0.08, [-0.03, 0.05] S2: 0.59 %, 1.61, [-0.56, 1.74]	S1: 0,52 %, 2.01, [-0.55, 1.59] S2: 1.20 %, 3.29, [-1.15, 3.55]	S1: 2.82 %, 2.36, [1.57, 4.08] S2: 0.04 %, 0.43, [-0.27, 0.35]
Fashion	S1: 0.01 %, 0.13, [-0.03, 0.04] S2: 1.04 %, 2.75, [-0.10, 2.17]	S1: 1.03 %, 3.81, [-0.01, 2.07] S2: 1.56 %, 2.69, [0.45, 2.67]	S1: 0.06 %, 0.83, [-0.16, 0.29] S2: 0.02 %, 1.25, [-0.49, 0.54]
Interior	S1: 0.01 %, 0.06, [-0.03, 0.04] S2: 0.00 %, 0.00, [0.00, 0.00]	S1: 7.48 %, 11.26, [1.48, 13.48] S2: 8,47 %, 14.09 , [-3.31, 20.25]	S1: 2.62 %, 3.04, [1.00, 4.24] S2: 0.00 %, 0.17, [-0.14, 0.14]
Leisure	S1: 0.40 %, 0.92, [0.07, 0.73] S2: 0.02 %, 0.11, [-0.05, 0.09]	S1: 3.32 %, 6.83, [0.86, 5.78] S2: 4.68 %, 4.90, [1.57, 7.80]	S1: 1.83 %, 3.61, [0.53, 3.13] S2: 0.13 %, 0.42, [-0.13, 0.40]
Others	S1: 0.54 %, 2.55, [-0.51, 1.59] S2: 0.29 %, 0.79, [-0.19, 0.77]	S1: 3.12 %, 9.94, [-0.99, 7.22] S2: 3.14 %, 4.21, [0.60, 5.68]	S1: 2.61 %, 3.24, [1.27, 3.94] S2: 7.36 %, 10.42, [1.06, 13.66]

Despite some significant differences, the overall changes appear limited. The largest absolute shift can be observed in the «Interior» cluster, where the proportion of returned items that were resold as used articles in a secondary market significantly decreased ($t(22)=3.040$, $p=.006$). A similar development is observed in the «Fashion» cluster ($t(77)=3.046$, $p=.003$). Moreover, the relevance of third-party brokers has increased

in the cluster «Others» (t(36)=-2.531, p=.020) and the share of donations has decreased in the category «Leisure» (t(42)=2.259, p=.031). Other recovery options, such as forwarding the items to suppliers, have lost relevance in the «Entertainment» (t(24)=4.603, p<.001), «Interior» (t(22)=3.439, p=.004) and «Leisure» (t(42)=2.617, p=.013) clusters.

4.3. Discussion

As previously mentioned (Asdecker, 2015, Hofmann et al., 2020), there are several ways to calculate the return rate. The results of this study show the magnitude of the differences. Future studies should thus always specify and disclose their respective calculation method. It is even possible that the large fluctuations in the figures published to date are partly due to these differences. In addition, this study confirms that large differences exist between product groups and the exceptional relevance of this data for fashion e-tailers (EHI Retail Institute, 2019b). In terms of cycle times, the data show that return transport is considerably slower than the typical next-day delivery that is common practice in outbound distribution, i.e., over two working days on average. Internal processing also takes approximately 1–2 working days. The reimbursement time varies between 1–5 working days, thereby leaving room for some improvement.

The costs per returned article differ significantly depending on the product category. This study further distinguishes between transport and processing costs. A returned article in the «Fashion» cluster costs relatively little, although in the case of transport costs, the low costs can be attributed to the observation that return shipments usually contain multiple items (see Table 6). In addition, textiles and shoes are processed more quickly compared to other product groups. A major reason for the higher processing costs in the «Interior» and «Entertainment» categories is that the processing is less easy to automate and is characterized by a higher manual share of work.

With regard to the recovery options, this study shows, in line with recent other publications (e.g., Pur et al., 2013, EHI Retail Institute, 2019b), that the overwhelming part of returned goods can be directly restocked and sold as new. The interviews that were conducted to ensure the validity of the second survey in light of the smaller sample size revealed that packaging is the main reason for the comparatively low share of returns that are sold as new in the «Entertainment» cluster. Many brands use packaging seals to guarantee the originality of the goods. If a customer orders an article and opens it, the seal is broken and the goods can no longer be sold as new, even though they work perfectly fine. The significantly lower proportion of donated returns compared to disposal is a source of concern. A member of the expert panel indicated that in many cases, it is cheaper to dispose of a return than to donate it. Besides, many e-tailers have problems finding trusted donees. Here, information systems, such as designated platforms, could help to better match supply and demand in the future.

Concerning changes over time, despite some significant differences, the overall picture appears rather stable. This is surprising since many e-tailers appear to have invested time and money in preventive measures that help to avoid returns (e.g., Walsh and Möhring, 2017, Wang and Ansell, 2020). However, it seems that these measures only help to keep the return rates from further increasing. At the same time, this finding is an indication that older data are not losing their credibility as quickly as expected or feared and that it is possible to quote such studies for a fairly long time.

Furthermore, the collected data allow for the derivation of market estimates. Weighting the reported 2018 values in each product cluster with the current revenue/shipment shares (see Table 3) results in an average alpha return rate of 16.59 %. Thus, approximately one in six outbound packages is later returned. With 1.99 billion shipments in German B2C e-commerce in 2019, including returns, this leads to the following estimation:

$$1.99\ billion\ shipments - \frac{1.99\ billion\ shipments}{1+0.1659} = 284\ million\ return\ shipments\ .$$

Approximately 72 % of this total can be attributed to the «Fashion» segment (see Table 10). Using those percentages leads to an average of 2.66 items per returned shipment, which results in a total of 755 million returned articles. Of these, approximately 87 % can be attributed to the «Fashion» cluster. This latter number highlights the importance of reducing the number of fashion returns in particular. In this context,

information technologies should be of great value, for example, by reducing size-related returns by means of data analysis and artificial intelligence (e.g., Urbanke et al., Yang and Xiong, 2019). There is a real lever to make the fashion e-tailers' business model more profitable (Asdecker, 2015).

The estimated share of returned items (see Table 10) can also be used to quantify further item-based market figures. For instance, a returned item costs 4.28 € (transport: 2.21 €; processing: 2.07 €) on average. This value is far below the existing estimates. If one were to assume higher costs, for example 15–20 € (Pur et al., 2013) or $30–$35 (Stock et al., 2006), it is questionable whether the business model could ever be profitable given the high measured return rates.

TABLE 10. AN ESTIMATE OF RETURN SHIPMENTS AND RETURNED ITEMS SHARES

Cluster	S1eRevenue/ shipment share	S2: Alpha return rate	S3: Items per returned shipment	Share of returned shipments (=(S1*S2)/ SUM(S1*S2))	Share of returned items (=(S1*S2*S3)/ SUM(S1*S2*S3))
Entertainment	35.57 %	5.38 %	1.18	11.53 %	5.11 %
Fashion	25.76 %	46.46 %	3.20	72.13 %	87.32 %
Interior	15.03 %	5.45 %	1.03	4.94 %	1.91 %
Leisure	11.92 %	10.30 %	1.57	7.40 %	4.36 %
Others	11.72 %	5.66 %	1.25	4.00 %	1.88 %

Not only the economic dimension of returns can be better evaluated with the collected data but also the ecological effects, which are thus far often neglected. According to Bertram and Chi (2018), the environmental impact of fashion returns depends on the return method. Edwards et al. (2009) estimate the emissions of a consumer return on the last mile to range between 362 g CO_2 and 4455 g CO_2. Despite an extensive search, the authors of this paper could not find any estimate for the total CO_2 footprint of a return. For this reason, a separate approximation is to be made based on the combination of figures that are published in Zalando's annual report. Zalando is one of the largest fashion e-tailers in Europe. Accordingly, Zalando's total carbon footprint in 2019 amounted to 262,511 tons of CO_2 (Zalando SE, 2020). Transport to customers, including returns, accounts for 61 %, or 160,132 tons of CO_2 (Zalando SE, 2020). Given Zalando's documented return rate of 50 % (Gassmann, 2018), of 53,377 tons of CO_2 can be attributed to returns. At the same time Zalando states that in 2019, it processed 144.9 million orders (Zalando SE, 2020). Assuming that each order leads to a package, the above-cited return rate of 50 % results in 72.45 million return shipments. Accordingly, the overall footprint of a return shipment is approximately 737 grams CO_2. It should be emphasized that this estimate is very conservative, because not all companies have Zalando's process efficiency and Zalando is already making great efforts to make its business model CO_2-neutral. Furthermore, some emissions, such as the disposal of unsaleable returns, are not included. If this figure is applied to the German market as a whole, the estimated 284 million return shipments would result in at least 209,308 tons of CO_2.

5. CONCLUSION, IMPLICATIONS, AND OUTLOOK

This paper presents the results of a longitudinal trend study among e-commerce retailers in Germany on consumer returns. It sheds light on the essential reverse part of the e-commerce business model, which companies are usually not particularly willing to provide information about (Stock and Mulki, 2009). To date, there have mainly been data points about individual companies, anecdotal evidence, or practitioner-oriented studies with a methodology that is not fully comprehensive. Furthermore, the literature review has shown that the values published thus far show an enormous range. Valid estimates for the number of returns and the associated costs or ecological effects could not be derived thus far. Given this research gap, the study at hand goes beyond the existing work and presents a systematic approach to gain numerous insights into what is also called the "necessary evil" (Petersen and Kumar, 2010) of e-commerce.

In conclusion, what is the overall contribution of this paper? Whetten (1989) distinguishes the following four categories: factors that explain a phenomenon (*what?*), the relationship between those factors (*how?*),

logical justifications for altered views (*why?*), and the conditions that limit generalizability (*who, where, when?*). This research adds to the e-commerce literature by focusing on the often neglected reverse part of the business model and contributing to three of these four categories.

First, we provide a comprehensive focused literature review that summarizes the available descriptive statistics on essential performance indicators *(what?, where?*). This overview allows interested scholars a quick introduction to the topic. As the numbers reported in previous literature are fragmented, the need for a well-structured data collection is evident.

Second, the data obtained for the German market demonstrate the societal, ecological, and economic impact (*what?, where?*) of consumer returns that make active returns management inevitable. Furthermore, the high return rates underline the need for further research specifically regarding technologies such as combining big data analytics with artificial intelligence to provide feasible solutions for preventive measures. Third, this research enables a better assessment of extant research. In other words, it tries to bring some order to the current chaos and gives justifications for altered views (*why?*). For example, it appears that there have been exaggerations in the past regarding the costs of a returned item (Stock et al., 2006, Pur et al., 2013). Some assumptions concerning return rates must also be critically reflected upon. For instance, Walsh et al. (2016) stated that "[…] computers ‚suffer' especially from high product returns". Thus, our results indicate that a generic perspective is neither suitable nor useful – it depends on the context. Return rates for fashion items are roughly five times higher than those for entertainment products such as consumer electronics. In addition, the total cost of processing fashion returns is only one-fifth of the cost of a returned entertainment product. This more nuanced perspective also allows for a more accurate assessment of the representativeness of previously published studies.

Fourth, the data obtained can also stimulate further research in the field of quantitative models and simulation models by providing input for the required parameter values. In addition, it is a source for data triangulation to validate the representativeness of other studies and for the justification of a specific research design, e.g., regarding the product category to focus on (impetus to *why?*).

Finally, fifth, the survey instrument presented in the digital appendix provides the basis for international replication studies (impetus to *where?*). While the current data refer to the largest European domestic market, Germany, which is one of the study's biggest limitations, other scholars can use the questionnaire to investigate the influence of regional differences, as implied by Nicola (2019).

In terms of managerial contribution, the findings of this research can be used to improve decision support systems. For example, the collected data are of particular value to companies that are currently planning to enter the German market and are thus trying to obtain better knowledge for designing return policies, calculating prices, and determining processing capacities. In addition, this study provides the necessary data for benchmarking efforts that help to ensure competitiveness. In this context, reference should again be made to the data provided in the digital appendix, which enables even finer evaluation options based on 20 product categories, which were aggregated into five clusters for the current analysis.

On the broader scale of the environment, this work helps to draw attention to the ecological consequences of returns in e-commerce. To date, the research community has paid little attention to the intended and unintended consequences of e-commerce. To create a more sustainable future, it is important to clearly address possible shortcomings. Two findings should be mentioned in this respect. First, we present an approach for estimating the total carbon footprint of returns, which needs to be further reduced. Second, this study helps to quantify the consumption of resources through the disposal of returns. Fortunately, the data show that disposal is the exception rather than the rule. Nevertheless, e-tailers obviously dispose of items more frequently than they donate them. On the one hand, these "dark" sides of the business model deserve attention. On the other hand, new business models can arise from them. In particular, solutions are needed to help better coordinate donors and grantees with the goal of obtaining more resources.

In the end, apart from the numbers and figures, consumer returns will remain an essential part of e-commerce. Given the projected high growth rates ahead, it is clear that the problem will become even more prevalent. A prerequisite for change is a thorough review of the status quo. In that regard, this work has

made an initial contribution to the field. We hope that other fellow researchers are motivated to build upon the work presented herein.

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Appendix 1: Online questionnaire [Excerpt]

Virtual cover letter

Dear expert,

Welcome to this study on consumer returns in e-commerce. The primary goal of this research is to gain insights into the often neglected returns management process, which is of great importance. We value your opinion!

Is there a benefit of participation? Yes! Only participants get access to the results directly after data evaluation. A generally accessible scientific publication will be made after a blocking period of 1.5 years. The collected data can improve your decision-making with regard to consumer returns and can be used for benchmarking purposes.

This is an anonymous survey. All information will only be used for scientific purposes. It takes about 12 to 15 minutes to finish the survey.

The survey requests some mandatory information that is necessary for the data analysis. Among others, please have an estimate of the following parameters available:

- *Number of outbound shipments in your most important product category in [year]*
- *Number of returned shipments in your most important product category in [year]*
- *Your company's e-commerce revenue in the last fiscal year*

Please answer the questions as accurately as possible. Be assured that there are no right or wrong answers. To achieve meaningful results, the largest possible sample is required. Therefore, please complete the questionnaire.

If you have any questions regarding this study, please contact us by e-mail: xxx.

Questions:

- *Question 1: Please indicate for which kind of company you are participating in this survey. [selection categories: Pure online retailer; Multi-channel or omni-channel retailer (stationary & online); Pure stationary retailer; I do NOT participate for a retailer]*

- *Question 2: Please select the product category in which your company generates the largest share of its e-commerce sales: [selection categories: Clothing/Accessories; Books/E-Books/Audio Books; Car/motorbike/accessories; Computer/Accessories/Games/Software Including Downloads/Electric Goods; DIY/Flowers; Furniture/Lamps/Decoration; Groceries/Food/Beverages; Health/Drugs/Medication; Hobby/Leisure articles; Home textiles; Household goods/Appliances; Jewelry/Watches; Office supplies; Pet supplies; Shoes/Footwear; Telecommunication/Mobile phone/Accessories; Toiletries/Cosmetics; Toys/Games; CDs/DVDs; Other product category (text field)]*

- *Information: We will again highlight this in the respective questions. Nonetheless, please confirm at this point that most of the following questions refer to the product category [Answer Q2] by clicking on "CONTINUE".*

- *Question 3: For how long can your customers return their ordered articles in product category [Answer Q2]?*

- *Question 4: Please provide your company's total number of outbound shipments that can be accounted for in the product category [Answer Q2] during [year].*

- *Question 5: Please provide the total number of shipments that have been returned to your company (or an appointed third party) that can be attributed to product category [Answer Q2] during [year].*

- *Question 6: How high was your shipment-based return rate in product category [Answer Q2] in [year]? [Example: You have sent out 1000 packages, of which 500 came back -> return rate = 50 %]*

- *Question 7: How high was your item-based return rate in product category [Answer Q2] in [year]? [Example: You have shipped 3000 articles, of which 1000 came back -> return rate = 33 %]*

- *Question 8: On average, how many articles did a returned shipment in product category [Answer Q2] contain in [year]?*

- *Question 9: What were the average transportation costs per returned item in product category [Answer Q2] in [year]?*

- *Question 10: What were the average processing costs (including possible write-offs and remarketing expenses) per returned item in product category [Answer Q2] in [year]?*

- *Question 11: What is your estimate of the average transport time that occurred after the consumer took the return to the logistics service provider in product category [Answer Q2] in [year] (in working days)?*

- *Question 12: What is your estimate of the internal processing time that occurred after the logistics service provider delivered the return to your facility in product category [Answer Q2] in [year] (in working days)?*

- *Question 13: How long did it take until the customer was reimbursed after taking his/her return to the logistics service provider in product category [Answer Q2] in [year] (in working days)?*

- *Question 14: What was the percentage of returned items that your company could directly resell as new after processing (A-returns) in the product category [Answer Q2] in [year]?*

- *[Only if [Answer Q14] < 100 %] Question 15: Which of the following recovery options did your company use for returned items in product category [Answer Q2] that could not be resold as new in [year] and to what extent?*

  - *Sell as used/returned products on secondary markets (outlet, eBay, etc.)*
  - *Sell to independent third-party brokers (remarketing specialist)*
  - *Donate to charitable organizations*
  - *Dispose as scrap*
  - *Other recovery option(s)*

- *Question 15/16: Please provide your company's e-commerce net revenue (after returns) during the last fiscal year (in Euro).*

Appendix 2: Literature Review: Return Rates Details

Paper	Peer reviewed	Region	Data type	Year of data collection (if available)	Data source / survey population	Cross-sectional rates (type)	Fashion rates (type)	Entertainment rates (type)	Leisure rates (type)	Interior rates (type)	Other rates (type)
Hofmann et al., 2020	X	DE	Enterprise data	-	Wholesaler	-	-	-	5.1 % (β) 7.7 % (α)	-	-
Cui et al., 2020	X	US	Enterprise data	2012–2015	Retailer	-	-	-	5–14 % (n.s.)	-	-
Wang and Ansell, 2020	X	CN	Enterprise data	2016	Taobao.com stores	4–40,6 % (n.s.)	-	-	-	-	-
Appriss Retail, 2019	-	US	Survey	2019	Retailer	9,6 % (n.s.)	-	-	-	-	-
Nicola, 2019	-	EU	Cited data	2018	Logistics provider	30–50 % (n.s.)	-	-	-	-	-
Shang et al., 2019	X	US	Enterprise data	1998–2004	E-tailer	-	7 % (n.s.)	-	-	-	-
Jack et al., 2019	-	-	Case study	-	Retailer	1–75 % (n.s.)	-	-	-	-	-
EHI Retail Institute, 2019b	-	DE	Survey	2018–2019	E-tailer	20 % (β)	40 % (β)	10 % (β)	10–30 % (β)	20 % (β)	< 10 % (β)
Asdecker and Karl, 2018	X	DE	Enterprise data	2012–2013	E-tailer	-	59.8 % (α)	-	-	-	-
Abbey et al., 2018	-	US	Enterprise data	-	Retailer	16 % (γ)	-	-	-	-	-
Araújo et al., 2018	X	BRA	Interviews	2015	Consumer & e-commerce segment manager	3-4 % (γ)	-	-	-	-	-
Difrancesco et al., 2018	X	DE	Enterprise data	-	E-Tailer	-	40 % (n.s.)	-	-	-	-
Sahoo et al., 2018	X	US	Enterprise data	2010–2012	Retailer	-	15–22 % (n.s.)	-	-	7 % (n.s.)	-
Walsh and Möhring, 2017	X	EU	Enterprise data	-	Manufacturer and retailer	-	20 % (α)	-	-	-	-
Vilar-Zanon et al., 2017	X	US	Enterprise data	-	Retailer	-	25 % (n.s.)	-	-	-	-
Ellis, 2017	-	US	-	-	-	33 % (n.s.)	-	-	-	-	-
Woods, 2017	-	US	Cited data	-	Reverse logistics association	25–40 % (n.s.)	-	-	-	-	-
Asdecker et al., 2017	X	DE	Enterprise data	2014–2015	E-tailer	-	52.9 % (β) 63.3 % (α)	-	-	-	-
Bernon et al., 2016	X	UK	Enterprise data	2013–2014	Retailer and returns management 3PL organizations	-	8.1–38.2 % (γ)	6.4–10.3 % (γ)	-	5.0–12.7 % (γ)	-
Minnema et al., 2016	X	EU	Enterprise data	2014–2018	E-tailer	-	-	8.3 % (n.s.)	-	10 % (n.s.)	-
Ng and Stevens, 2015	-	-	Anecdotal	-	Logistics provider (Optoro)	10–25 % (n.s.)	30 % (n.s.)	-	-	-	-
Pettypiece, 2015	-	-	-	-	-	-	30 % (n.s.)	-	-	-	-
Stevens, 2014	-	-	-	-	-	-	50 % (n.s.)	-	-	-	-
Hong and Pavlou, 2014	X	US	Enterprise data, survey	-	Consumers	18 % (n.s.)	-	-	-	-	-
Rao et al., 2014	X	US	Enterprise data	2010	Retailer	-	15 % (β)	-	-	-	-
Banjo, 2013	-	-	Survey	-	-	33 % (n.s.)	-	-	-	-	-
Pur et al., 2013	-	DE	Survey	2012	E-tailer	18 % (β)	26 % (β)	-	-	-	-
Griffis et al., 2012	X	ASIA	Enterprise data	-	E-tailer	-	--	2–16 % (n.s.)		-	-
Douthit et al., 2011	-	-	Survey	-	Manufacturer, retailer	-	-	11–20 % (n.s.)	-	-	-
Rösch, 2011	-	DE	-	-	-	-	50–70 % (n.s.)	-	-	-	-
Rabinovich et al., 2011	X	US	Enterprise data	2005–2006	E-tailer	-	-	-	-	2 % (n.s.)	-

Paper	Peer reviewed	Region	Data type	Year of data collection (if available)	Data source / survey population	Cross-sectional rates (type)	Fashion rates (type)	Entertainment rates (type)	Leisure rates (type)	Interior rates (type)	Other rates (type)
Petersen and Kumar, 2010	-	US	Enterprise data	-	Retailer	-	16 % (n.s.)	-	-	-	-
Mollenkopf et al., 2007	X	US	Interview	2005	Retailer	-	5–20 % (n.s.)	5–20 % (n.s.)	5–20 % (n.s.)	-	< 5 % (n.s.)
Brohan, 2005	-	-	Survey	2005	E-tailer	< 10 % (n.s.)	-	-	-	-	-
Stock, 2004	-	-	Cited data	-	National Retail Federation	5.6 % (n.s.)	-	-	-	-	-
Catalog Age, 2002	-	US	-	-	-	-	10–40 % (n.s.)	-	5–10 % (n.s.)	-	-
Rogers et al., 2002	X	-	-	-	Retailer	-	< 40 % (n.s.)	-	-	-	-
Thomas, 2001	-	-	Anecdotal	-	Consulting firm and research firm	5.5–7.2 % (n.s.)	40 % (n.s.)	-	-	-	-
Del Franco, 2000	-	US	Anecdotal	-	Consulting firm	5–7 % (n.s.)	30 % (n.s.)	25–35 % (n.s.)	2–5 % (n.s.)	-	-
Rogers and Tibben-Lembke, 1998	X	US	Survey	-	Manufacturer, wholesaler, retailer, service provider	6 % (n.s.)	-	-	-	-	-

Legend: - = not available; α= shipment-based return rate; β = item-based return rate; γ = revenue-based return rate; n.s. = return rate not specified

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