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# Exploring price tolerance in online retail: A comparative analysis of price comparison website use and repeat purchases

Jan Berends<sup>1</sup> · Torsten J. Gerpott<sup>1</sup>

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## Abstract

The present empirical study is the first research to examine how the price tolerance of online buyers correlates with price comparison website (PCW) usage and customer relationship status (CRS). Longitudinal sales data of power tools and household appliances in 8,097 transactions from a German online shop and scraped PCW price data over a 6-months period in 2021 are used for the analysis. Consumer demand falls on average by around 80% per less favorable PCW rank. In addition, PCW (new) customers show significantly less price tolerance than organic (existing) customers. A small but significant interaction effect induces that the correlation of CRS and price tolerance is stronger for organic than for PCW customers.

**Keywords** Customer relationship · E-commerce · Online retailing · Price comparison websites · Price tolerance · Repeat purchase behavior

## 1 Introduction

As a widely accepted conceptual framework in consumer behavior research and with focus on traditional retail, Zeithaml [127] describes the purchase decision of a potential customer (PDC) as a process. In this process, potential buyers compare the perceived quality of a product with its perceived sacrifice, i.e., price. An increased price is thereby related to a decreased purchase probability [117]. This relationship is influenced by a customer's price tolerance. Price tolerance is a theoretical construct

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which reflects the maximum price premium the buyer is willing to accept in the sense of the difference between a merchant's price and the lowest available market price. Potential explanations for the existence of price tolerance are preferences for a specific vendor or unawareness of cheaper alternatives [60, 78].

Price tolerance in general has revoked considerable attention in scholarly marketing research because of its direct impact on profitability [27, 101]. Less attention has been paid towards the role of price tolerance in the PDC in online environments. The increasing share of e-commerce in overall retail sales [42] necessitates to reflect the applicability of offline PDC to online settings as the buying process of e-customers differs significantly from brick-and-mortar retail. Intrinsic as well as extrinsic cues [127] that influence the perceived product quality - such as lack of quality inspection, trust needed to consign personal data as well as time disparity of payment and delivery - are different for online compared to offline purchases [41]. A prototypical overview of PDC relevant differences is provided in Table 1.

In traditional retail, the number of available vendors is limited by *spatial constraints* of relevant geographical markets and the need to set up *physical points of sale*. Offline customers can *inspect the product quality* before purchase [13, 110]. Online, customers must rely on the information provided by the retailer, especially for look-and-feel products [24, 76]. However, the higher number of *available retailers* leads to lower *search* and *switching costs* online [13, 83] which in turn increases overall consumer *price transparency*. In addition, the *exchange of resources* takes place asynchronously and customers are forced to *share personal data* during the online purchase process as they cannot pay anonymously in cash like in offline transactions [52]. The seller or third parties could use personal data of the buyer for activities which are not in a consumer's best interest [54, 98]. This contributes to increased *fraud possibilities* online compared to offline [32, 63]. For instance, merchants could promise performance dimensions they do not deliver by shipping a defective product or illicitly pass on sensitive customer information. Although academic findings are not totally unanimous [19], online customers tend to develop a lower level of *price tolerance* compared to their offline counterparts [12, 22, 37, 47, 116].

Previously unavailable price aggregators, i.e., price comparison websites (PCW), are nowadays used by many consumers [57, 60, 94]. A PCW refers to a website on which consumers can simultaneously compare offers of a large number of online

**Table 1** Prototypical differences in the buying process online vs. offline retail

Properties	Online retail	Offline retail
Spatial constraints	Low	High
Physical points of sale	No	Yes
Quality inspection	Limited	Physical
Available retailers	Many	Few
Search costs	Low	High
Switching costs	Low	High
Price transparency	High	Low
Price tolerance	Low	High
Exchange of resources	Delayed	Simultaneous
Personal data sharing	Yes	No
Fraud possibilities	Many	Few

shops relatively effortlessly [12, 44]. Besides (1) meta-search engines which merely juxtapose competitor prices [51] such as *Shopzilla* or *billiger.de*, there are (2) comparison websites with buying options such as *Google Shopping* or *idealo* and (3) social-shopping-communities such as *DealNews* or *mydealz*. These online intermediaries contribute considerably to improve price transparency and consequently to reduce online search costs of consumers [26, 75, 115]. PCW alter the interplay between objective price and price perception as suggested in the PDC framework [127]. Consequently, PCW customers ( $C_{\text{Search}, X}$ ) may exhibit lower levels of price tolerance compared to those of organic origin ( $C_{\text{Organic}, X}$ ).

The customer's relationship status (CRS) with a seller is another aspect of the Zeithaml PDC framework [44, 46, 53]. CRS indicates whether a consumer has already bought from a seller ( $C_{X, \text{New}}$  = new customer;  $C_{X, \text{Existing}}$  = repeat customer). Customer retention has been subject to academic discourse since the emergence of online markets [92, 99, 112]. As the cost of acquiring a new online customer can be up to five times as high as retaining an existing one [8], Reichheld and Schefter [104] identify the perseverance of repeat buyers as one of the key success factors of e-tailers. Buyers who already know a seller and return to him to place a repeat order tend to have a higher level of trust [65] and might receive other benefits such as loyalty program rewards or reduced shipping cost on repeat purchases [50]. In turn,  $C_{X, \text{Existing}}$  could be positively correlated with the willingness to accept higher product prices [29, 69, 87, 101, 105, 125].

Whether the correlation of price tolerance and PCW use depends on the CRS is largely unresearched. For example, the correlation of using a PCW and price tolerance could be more pronounced for repeat than for new customers.

We investigate the role of PCW usage and CRS for the level of price tolerance and suspect a potential interaction effect for homogeneous durables on online retail markets. Few empirical research tests our predictions utilizing transactional data. Existing empirical studies instead primarily rely on surveys to derive their findings [103]. The present paper contributes to closing this research gap. We use longitudinal transactional data of more than 5,000 stock keeping units of a German online retailer for power tools and household appliances (actual sales instead of claimed or intended purchases) and price data from a major German PCW to show a correlation of price tolerance with PCW use and CRS. The purchase history includes 101,700 orders from 92,600 customers. An API is used to extract competitor price information from the PCW four times a day from January 2021 to July 2021. After cleansing and filtering, we obtain 8,097 distinct transactions with their respective price rank in relation to competitors listed on the PCW over the 6-months period. Our findings suggest that PCW users are significantly less price tolerant than organic customers. The same holds for new customers compared to existing customers. We only detect a small interaction effect between PCW use and CRS.

**Table 2** Previous relevant research

Reference	Year	Study design	Sample size	Online specific	Price tolerance	PCW usage	CRS	Trust/loyalty	Durables	Identical goods
[2]	2010	Survey	436	✓	-	-	✓	✓	✓	✓
[11]	2015	Survey	347 <sup>a</sup>	✓	✓	✓	-	✓ <sup>b</sup>	✓	✓
[17]	2001	Survey	9,010 <sup>c</sup>	-	✓	-	-	✓	✓	✓
[21]	2013	Survey	258	✓	-	✓	-	-	✓	✓
[25]	2003	Survey	134	✓	-	-	-	✓	✓	✓
[27]	2015	Survey	455	-	✓	-	-	✓	-	-
[35]	2015	Survey	535	-	✓	-	-	✓	-	✓
[50]	2008	Survey	802	✓	✓	-	✓	-	✓	✓
[51]	2016	Click-stream data	6,048	✓	-	✓	-	-	-	-
[55]	2013	Survey	202	✓	✓	-	-	✓	✓	✓
[56]	2017	Survey	175	✓	-	-	-	✓	-	-
[59]	2005	Survey	416	✓	-	-	-	✓	✓	✓
[60]	2014	Survey	160	✓	✓	✓	-	-	✓	✓
[69]	1991	Purchase diaries	>7,000 <sup>d</sup>	-	✓	-	-	✓	-	✓ <sup>e</sup>
[68]	2003	Purchase history	44,056	-	✓	-	-	✓	-	-
[70]	2012	Survey	314	✓	✓	-	-	-	✓	-
[74]	2020	Survey	345	✓	-	✓	-	-	✓	✓
[77]	2014	Survey	1,871	-	-	-	✓	✓	-	-
[87]	2020	Survey	200	-	✓	-	-	✓	✓	✓
[93]	2007	Survey	563 <sup>f</sup>	-	-	-	-	✓	✓	-
[95]	2020	Survey	120	✓	✓	-	-	✓	✓	✓
[96]	2005	Survey	549	✓	✓	-	-	✓	✓	-
[105]	2002	Customer data bases	>16,000 <sup>g</sup>	-	-	-	-	✓	✓	-
[106]	2011	Customer profiles	51	✓	-	✓	-	✓	✓	-
[113]	2002	Survey	1,211	✓				✓		
[114]	2017	Survey	4,492 <sup>h</sup>	-	✓	-	✓	✓	-	✓
[116]	2009	Survey	557		✓			✓		
[117]	2017	Survey & transaction data	6,423	-	✓	-	✓	✓	-	✓
[120]	2020	Survey	1,112	✓	✓	✓	-	-	✓	✓

**Table 2** (continued)

Reference	Year	Study design	Sample size	Online specific	Price tolerance	PCW usage	CRS	Trust/loyalty	Durables	Identical goods
[124]	2014	Survey & transaction data	7,797 <sup>i</sup>	-	✓	-	✓	✓	✓	✓
[126]	2008	Survey	1,200	✓	✓	-	-	-	-	-
Present study	2022	Sales data	8,167	✓	✓	✓	✓	-	✓	✓

✓ = adressed in study

- a) Three studies consisting of undergraduate student (n=176) and national consumer panel (n=171) surveys
- b) Although Bodur et al. [11] do not investigate trust specifically, they examine the effect of PCW ratings on consumer reference price levels which we interpret as a result of differentiated trust in retailers
- c) Three studies consisting of consumer interviews (n=4,380; n=4,470) and product managers as industry experts (n=160)
- d) Two studies consisting of an ADTEL purchase diary panel with >375 families and >7,000 purchases by Burke Marketing Research as well as a IRI coffee data base containing prices and other store environment related information on a weekly basis over a 105-week time span
- e) Although different product categories and brands are covered, the authors only include identical groups of products/brands
- f) Two studies consisting of a cross-sectional study (n=362) and a longitudinal study (n=201) of buyers, salespeople, and sales managers
- g) Customer databases of four companies, a large high-tech corporate service provider, a large U.S. mail-order company, a French retail food business, and a German direct brokerage house
- h) Two samples consisting of primary (n=334) and secondary (n=4,158) survey data
- i) Four studies consisting of longitudinal transaction data of >7,200 customers over four years (2008–2012), customer survey data (n=151), nested customer and salesperson survey data (n=308) and a negotiation experiment (n=138)

## 2 Study hypotheses

Table 2 profiles previous empirical investigations with direct relevance for the present study. We refrain from a detailed discussion of each piece of work in Table 1 and will refer to the publications in Sect. 2.1 to 2.3 when appropriate.

### 2.1 Price tolerance of price comparison site users

Price search in general is the effort made to obtain and compare price offers of different vendors [118]. In traditional retail, price searching behavior can be specified into *incidental*, *temporal*, *spatial* and *spatiotemporal* price search accounting for individual differences in the proneness to search across shops and time [39]. For example, a price conscious consumer might also search outside the retailer for low prices [78] and might even enjoy the process of doing so [3].

Specifically, online price search behavior is strongly influenced by the cognitive capability and motivation of customers to search for and process online price infor-

mation [31]. Several models try to explain general online search behavior with relevant factors such as perceived search efficiency, motivation to price search [58, 73, 102] or other external factors [15].

PCW provide buyers with the opportunity to search and evaluate alternatives of a large number of retailers online [60]. Consumers who are guided to a merchant's offer through a PCW are likely to align their subjective price limit further to the objective lowest market price. Thus, they could be less willing to accept a merchant's offer above the lowest market price compared to consumers who reached the merchant organically. Wang et al. [122] show that the importance of PCW is more pronounced for products whose attributes are known before purchase (search products) than after purchase (experience products). This is supported by Bei et al. [9] who find different use of information sources in online search behavior for search and experience products.

Similarly, Bodur et al. [11] report stronger rating impact on price tolerance of consumers using a PCW for high-priced than for low-priced retailers. Reliable information from PCW reduces consumer uncertainty and their dependency on memory or further search for price assessment at the time of purchase [60].

Our study does not concentrate on how prices are searched but rather investigates the correlation of price search through a PCW and price tolerance of consumers. Furthermore, Deragatu et al. [24] and Iyer and Pazgal [57] suggest that PCW do not only increase the sellers' price competition but also the buyers' price sensitivity. Empirical evidence indicates that online customers become less price tolerant after using a PCW [60]. Similarly, Kumar et al. [71] found that lower search costs lead to higher price elasticities and lower price dispersion. This effect is particularly pronounced for standardized (search) products as they are easier to compare on a PCW [60]. As PCW ease the price search process for online customers [16, 44, 48], we expect that the influence on price tolerance is particularly strong.

One may expect that PCW attract particularly price-sensitive customers [106, 119] as these consumer tends to invest more effort to find the best price [120]. For example, Holland et al. [51] provide evidence suggesting that consumers use PCWs not as a primary search substitute but as an additional source of information, indicating a generally high level of price sensitivity among  $C_{\text{Search}, X}$ . The presence of this potential selection bias prevents us from definitively establishing a direct cause-and-effect relationship between PCW usage and price tolerance. Instead, it is more reasonable to infer that  $C_{\text{Search}, X}$  typically exhibit lower levels of price tolerance due to factors other than the mere act of being guided through a PCW to a merchant's offer.

In summary,  $C_{\text{Search}, X}$  are assumed to have a relatively low level of price tolerance, since they do not only gather price information of the retailer but also of competitors through a previous visit on a price search engine. In contrast,  $C_{\text{Organic}, X}$  are expected to have less information about the competitiveness of the retailer's product prices, thereby a relatively lower level of price awareness. This results in:

**Hypothesis 1 (H1)** Price comparison website usage correlates negatively with price tolerance of online retail customers.

## 2.2 Price tolerance of repeat buyers

Repeat buyers establish a strong connection with the retailer, leading to distinct behaviors compared to new customers [128]. A multitude of empirical research finds that repeat buyers show higher levels of price tolerance than new customers [10, 17, 27, 40, 61, 69, 79, 81, 108, 116]. They prefer to maintain their business relationship with a familiar retailer rather than undertaking the added costs and risks associated with searching for alternatives.

In studying the effects of loyalty on consumer price sensitivity with customer heterogeneity, Yoon & Tran [125] find that the higher price tolerance of loyal customers is predominantly attributed to value-conscious loyal customers, who make repeat purchases based on their preference for the service offered, as opposed to deal-prone loyal customers, whose repeat purchases are primarily driven by economic incentives. Pandey et al. [95] find that the extent to which price tolerance increases for repeat buyers varies depending on the type of product and the retailer. Similarly, Krishnamurthi and Papatla [68] show that the relationship between price tolerance and repeat purchase behavior is dynamic and fluctuates across different consumer segments and product categories. This variability across product categories is also noted by Dube et al. [30].

Compared to offline, Devaraj et al. [25] suggest that the CRS effect on price tolerance might be even more pronounced online compared to offline. This perspective finds support in the work of other researchers as well [5, 44, 113]. Shopping with a familiar retailer mitigates uncertainty in an otherwise anonymous online landscape with its extended fraud possibilities [64, 116]. Switching costs also play a significant role [89]: Customers with low (perceived) switching costs are more inclined to explore competing offers and thus tend to be less price tolerant than their counterparts with higher switching costs [20, 43].

Furthermore, repeat customers benefit from tangible loyalty rewards programs such as reduced shipping costs, complimentary samples/products, or discounts on immediate/future purchases which can increase their tolerance for the quantifiable purchase price [49]. In addition, intangible purchase related rewards or (status-oriented) point-based loyalty programs, granting special treatments such as invitations to exclusive events and special offers, can increase customer price tolerance since they provide additional value beyond the purchase price itself [49, 88]. Online retail, with increased access to purchase history and behavior, facilitates social shopping experiences for customers by delivering highly relevant personalized recommendations [67]. This capability can be leveraged as a bonding tool to keep customers engaged with a company.

Conversely, CRS could become a less important driver of price tolerance online if the seller uses payment systems, like *PayPal* or *Amazon Pay*, which reduce a consumer's risk of being deceived [34, 80]. Wang et al. [121] detect no significant relationship between repeat purchases and price tolerance among Chinese online customers. However, this finding might be explained with the infant stage of the Chinese e-tail market. Other researchers argue that repeat customers are less price tolerant than new customers as they generally demand higher discounts in return for their loyalty, are more knowledgeable about the firms' pricing tactics or are more insensitive

to price promotions [14, 45, 62, 90, 100, 105, 117]. The notion that recurring customers expect firms to offer lower prices in return for repeat purchases is also supported by Umashankar et al. [117] who find that repeat buyers are more concerned about the price than new customers. Surveying Portuguese shopping mall customers, Ferreira and Coelho [35] detect that buyers with low levels of price tolerance tend to be particularly brand loyal. A reason for this observation is seen in the peculiar mall setting in which repeat price conscious customers tend to be loyal to a lower priced brand.

Depending on the product category, Reinartz and Kumar [105] report that recurring buyers pay 5–7% less on average. According to their reasoning, all potential premium repeat buyers are willing to pay is canceled out by retention actions such as price promotions or loyalty cards and superior price-value knowledge of previous purchases. This loyalty-discount circle is expected to be particularly pronounced when customers focus on price instead of product quality [124]. Another potential explanation is that customers resent firms who try to exploit the customer relationship for corporate profit. In consequence, repeat buyers must not be seen as naïve price takers but they should rather be taken as rational actors who try to maximize their personal welfare [4]. In other words, sales increases from repeat purchasers come at a cost for the firm.

The direction of causality is also debated: Some scholars argue that repeat purchases do not reduce the level of price tolerance, but instead that price conscious, i.e. price intolerant, buyers have a lower tendency to become repeat customers [35, 38, 68, 85, 117]. Another aspect is that a positive price association of a past purchase seems to play an important role for customer retention [2, 59].

To sum, most scholars propose a positive association between  $C_{X, \text{Existing}}$  and the level of price tolerance, i.e., compared to  $C_{X, \text{New}}$  who have not yet placed any orders, repeat buyers should have a higher level of price tolerance. We propose:

**Hypothesis 2 (H2)** Repeat customers are more price tolerant than new customers.

### 2.3 Interaction of customer relationship status and usage of price comparison site in the context of price tolerance

Empirical work on the effect of  $C_{X, \text{Existing}}$  with the use of PCW in the context of price tolerance is scarce. Dickinger and Stangl [27] suggest that the influence of PCW is heterogeneous among consumers. Ratchford [103] proposes a potential interdependence of PDC criteria in general. In addition, Kim and Peterson [63] as well as Sarkar et al. [109] found variance in the influence of trust which suggests a reciprocal association with other explanatory variables. From Sarkar et al. [111] and Setiawan and Achyar [111], one might expect that CRS moderates the correlation of PCW use and price tolerance.

$C_{X, \text{Existing}}$  are expected to have a stronger price tolerance compared to  $C_{X, \text{New}}$  because they have already experienced that the retailer has fulfilled his obligations to such a degree that they repeatedly order from the store.  $C_{X, \text{New}}$  lack this experience and therefore are more prone to seek price validation through PCW. Our argument is related to the work of Escobar-Rodriguez [33], Kim et al. [65], Kim and Peterson [63], Sarkar et al. [109] and Setiawan and Achyar [111], who measure the influence of

trust and price tolerance on PDCs. We argue that  $C_{X, \text{Existing}}$  are less likely to be influenced in their price tolerance using a PCW and thus show a higher price tolerance than  $C_{X, \text{New}}$ , not only due to trust but also due to other previously outlined factors such as discounts for subsequent purchases or search expenses. Accordingly, we propose:

**Hypothesis 3 (H3)** Repeat customers using a price comparison site show a higher price tolerance than new customers.

### 3 Methods

This study is conducted in a natural field setting and classifies customers of longitudinal sales data from a German online retail shop by PCW ( $0 = C_{\text{Organic}, X}$ ;  $1 = C_{\text{Search}, X}$ ) and CRS ( $0 = C_{X, \text{New}}$ ;  $1 = C_{X, \text{Existing}}$ ).

#### 3.1 Sample

Transactional data from a German<sup>1</sup> online store for tools and household appliances were obtained. The use of behavioral data distinguishes this study from most previous research with findings based on survey data likely to be plagued by common method bias. The online store maintains around 5,000 stock-keeping units (SKUs) with approximately 1,000 visits and 90 purchase orders per day. The product portfolio mainly consists of non-look-and-feel products [36], whose quality can be inferred from the information provided online and which exhibit little quality variance within a manufacturer's model line [28, 84]. Products can thereby be considered quality identical [42] with competing offers. Exposure to a PCW is expected to decrease online customer price tolerance especially for non-look-and-feel products [60]. Therefore, our sample set is especially suited to investigate the relationship between PCW usage and price tolerance.

The analysis is based on two distinct data sources: Firstly, we obtained 101,700 orders from 92,600 customers of the cooperating online store spanning from June 2013 to September 2021. Secondly, an API was used to extract an *idealo*<sup>2</sup> price report four times a day during a 6-month period from 22-01-2021 to 09-07-2021, which includes anonymized competitor price information and the relative price rank of offered products. To ensure high data quality, we excluded orders without a direct link to a specific *idealo* price report, as well as SKUs that were purchased less than ten times to reduce selection bias. Additionally, we removed outliers consisting of orders with more than 20 identical products. Finally, our analysis includes 7,471 anonymized customers and 159 unique products in 8,097 transactions.<sup>3</sup> In addition to the respective price rank

<sup>1</sup> Over 99% of customers originate from Germany (75%) or neighboring German-speaking countries (24%). The remaining customers stem from other EU countries (<1%).

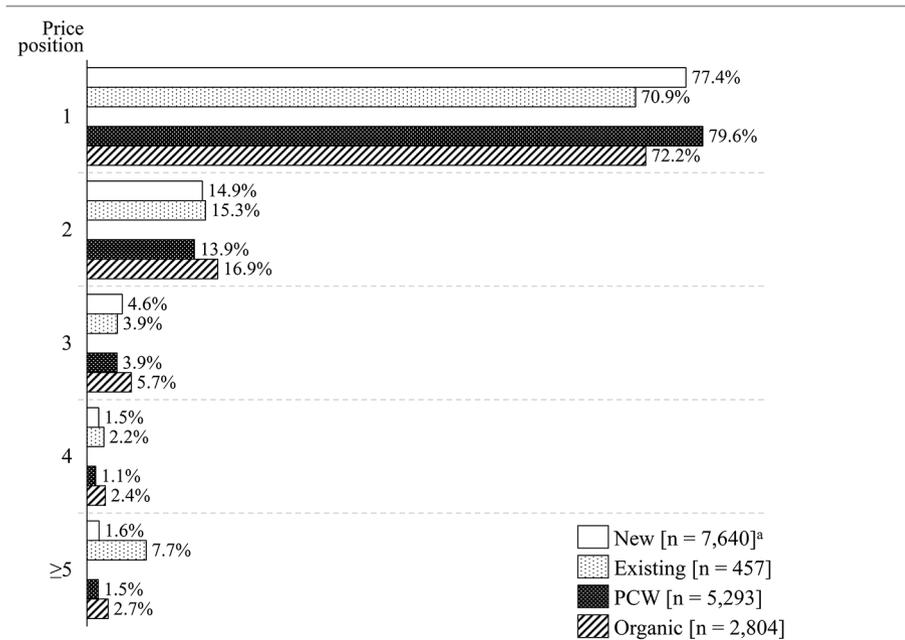
<sup>2</sup> *Idealo* is the major German PCW with more than 30 million monthly visitors in 2022.

<sup>3</sup> 82% of the products are power tools, 12% are kitchen appliances and the remaining 6% consist of household electronics such as personal hygiene electronics, garden tools or other domestic appliances.

compared to competitors listed on the PCW, our dataset provides information on the customers' PCW use to make the purchase, as well as their CRS.

### 3.2 Measures

The purchase decision of consumers is not made based on an objective price but rather on a subjective perceived price [86]. According to range-frequency theory, customers acquire, store and use an array of reference price information to judge the price level of a given deal [97]. Niedrich et al. [91] show that this perceived price assessment is influenced by its relative price rank in a set of available reference prices. This effect is even more pronounced with PCW as the simultaneous presentation of multiple offers increases rank and frequency information [11, 86]. The response of online consumers on the relative price rank of a product on a PCW can hence be interpreted as the relative level of price tolerance towards that retailer. Specifically, we operationalize price tolerance through the price rank in the *idealo* price report of an SKU at the time of purchase. Although *idealo* prices do not always constitute the actual lowest obtainable market price [6, 107], they represent the price knowledge which is accessible for the average consumer with reasonable effort. The strong relationship of price rank and sales quantities is illustrated in Fig. 1. A logistical regression supports this observation: 87.2% of the variance in sales quantities can be explained by price rank ( $p < .001$ ).



**Fig. 1** Percentages of products sold for each respective price rank by use of price comparison website and customer status. (a) Total=8,097 products sold (=100%) in the six-months period from January 2021 to July 2021

**Table 3** Mean price rank by use of price comparison website and customer status

		Sales channel <sup>a</sup>					
		Organic ( $C_{\text{Organic}, X}$ )		PCW ( $C_{\text{Search}, X}$ )		Total	
		$N^b$	$M(\text{SD})^c$	$n$	$M(\text{SD})$	$n$	$M(\text{SD})$
<b>Customer status</b>	<b>New</b> ( $C_{X, \text{New}}$ )	2,539	1.48 (1.092)	5,101	1.31 (0.772)	7,640	1.37 (0.894)
	<b>Existing</b> ( $C_{X, \text{Existing}}$ )	265	1.78 (1.422)	192	1.42 (0.989)	457	1.63 (1.270)
	<b>Total</b>	2,804	1.50 (1.130)	5,293	1.32 (0.781)	8,097	1.38 (0.921)

a) Previously visited page before landing on website to make a purchase

b)  $n$ =number of products sold

c)  $M$ =mean price rank. Value in brackets is the standard deviation (SD) of the mean price rank

Table 3 summarizes descriptive statistics of the dependent measure.  $C_{\text{Search}, X}$  account for 65% of all customer purchases, whereas the remaining 35% are generated organically. Holland et al. [51] report similar PCW use ratios in samples from Germany ( $C_{\text{Search}, X} = 60\%$ ) and the U.S. ( $C_{\text{Search}, X} = 73\%$ ). 94.4% of all customers of our sample are new customers which may bias our statistical analyses.

## 4 Results

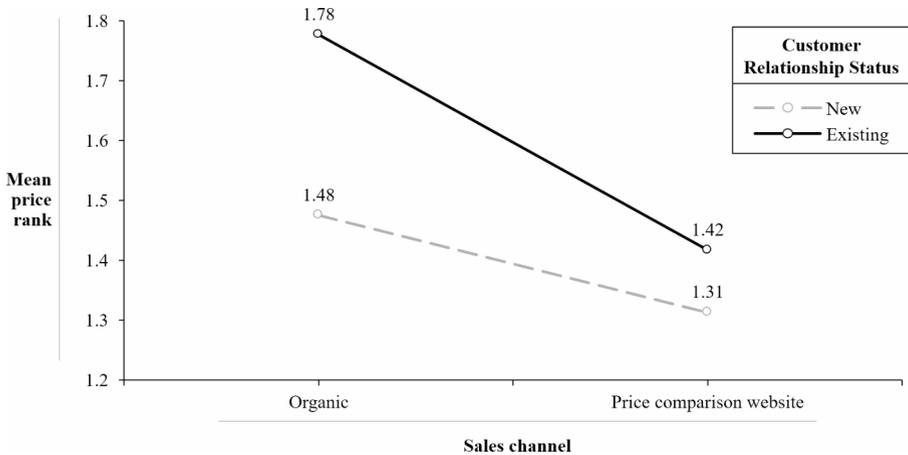
A two-way analysis of variance is conducted with price rank, i.e., price tolerance, as the dependent criterion. Table 4 summarizes the results of this ANOVA.

*Negative correlation of PCW usage and price tolerance:* We proposed in H1 that  $C_{\text{Search}, X}$  are less price tolerant than organic buyers. The difference in mean level of price tolerance strongly supports H1 ( $M_{\text{Search}, X} = 1.32$ ,  $M_{\text{Organic}, X} = 1.50$ ,  $F=33.75$ ,  $p<.001$ ). For robustness, further univariate analyses using a Pearson's chi-squared test ( $\chi^2=93.86$ ,  $p<.001$ ), Kruskal-Wallis-test ( $H=62.62$ ,  $p<.001$ ) and a pairwise t-test for heterogeneous variances (Levene  $F=258.33$ ,  $T=8.95$ ,  $p<.001$ ) confirm this finding, although the effect size is rather small (Cohen's  $d=0.23$ ).

*Positive correlation of customer relationship status and price tolerance:* H2 predicted that  $C_{X, \text{Existing}}$  are more likely to be price tolerant than  $C_{X, \text{New}}$ . Comparing the mean level of price tolerance of those two buying groups ( $M_{X, \text{New}} = 1.37$ ,  $M_{X, \text{Existing}} = 1.63$ ,  $F=28.04$ ,  $p<.001$ ) strongly supports H2. Supplementary univariate analyses using a Pearson's chi-squared test ( $\chi^2=12.20$ ,  $p=.016$ ), a Kruskal-Wallis-test ( $H=6.38$ ,  $p=.012$ ) and a pairwise t-test for heterogeneous variances (Levene  $F=207.32$ ,  $T=-4.33$ ,  $p<.001$ ) confirm the effect of CRS on price tolerance.

**Table 4** Two-way analysis of variance of price rank by price comparison website use and customer status

	df	F-value	$p<$	Partial $\eta^2$
Corrected model	3	35.875	0.001	0.013
Customer status	1	33.754	0.001	0.004
Price comparison website use	1	28.035	0.001	0.003
Customer status x price comparison site use	1	6.039	0.014	0.001



**Fig. 2** Mean price rank on a price comparison website by customer relationship status and sales channel

Although with a slightly larger effect size than H1, the effect is still rather small (Cohen's  $d = -0.29$ ).

*Interaction effect of price comparison website usage and customer relationship status on price tolerance:* As per H3, an interaction effect of the PCW usage and CRS on price tolerance level is assumed. Although this effect is significant ( $F = 6.039$ ,  $p = .014$ ), it is less pronounced than for the main effects of PCW and CRS. Figure 2 graphically clarifies this interaction. The difference between organic and PCW consumers is more pronounced for  $C_{X, \text{Existing}}$  ( $1.78 \rightarrow 1.42$ ) than for  $C_{X, \text{New}}$  ( $1.48 \rightarrow 1.31$ ), resulting in a 20.2% difference and an 11.5% difference in the observed mean price rank, respectively.

## 5 Discussion

The present empirical study explores how the use of PCW and the CRS are related to the price tolerance of online retail shoppers with transactional sales data, i.e., real buying behavior. Overall, we find that PCW users are less price tolerant in comparison to organic online shoppers. Similarly, new customers are less price tolerant than customers who previously bought at the online retailer.

We estimate that the relative PCW rank of a product explains 87.2% of the variance on the actual purchase decision of consumers. Considering the importance of the relative price rank, consumer demand falls by almost 80% for every increase in price rank. This underlines the importance for online retailers to be among, if not the cheapest, vendors to generate online demand.

PCW fundamentally changed the way in which consumers gather price information and compare online offers from a variety of different retailers. We detect that customers who use a PCW to find the offer of a retailer show significantly lower price tolerance than customers who were driven to the offer organically through

other channels such as direct search. Therefore, retailers might benefit from direct-to-consumer marketing strategies which motivate customers to not be routed via PCW in the PDC.

In online environments with a generally lower level of price tolerance, scholars argue that retailers do not necessarily benefit from the loyalty of recurring customers [72]. Nevertheless, our research suggests that existing customers show significantly higher price tolerance than new buyers. Instead of comparing prices on PCW before making a purchase, repeat buyers increasingly go directly to the retailer's website ( $C_{\text{Organic, New}} = 33.2\%$  of all new customer purchases vs.  $C_{\text{Organic, Existing}} = 58.0\%$  of all repeat purchases). Although price continues to play a major role in the PDC, retaining customers could hence serve as a mitigation of price competition [1, 59] as repeat buyers tend to give less importance to price than new customers [27, 95]. Former are willing to pay more [93] and speak favorably (word-of-mouth) to other potential buyers [7, 124]. Besides, research shows that other key performance indicators such as sales volume, profitability and market share are also positively affected by increased purchases of repeat customers [17, 30].

However, the extent to which an existing CRS reduces the correlation of PCW usage with price tolerance significantly deviates from previous research which often claims that the influence of a sustainable CRS is as important for the PDC as the price itself [63, 109]. A potential explanation for our lower observed effect of CRS could be the temporal offset of the studies and coupled environmental changes such as a the introduction of additional payment methods, the choice of sample data and a general change of customer trust in e-commerce.<sup>4</sup> Further, data was collected in Germany whereas many previous studies concentrated on Asian regions where cultural differences could explain a portion of the observed disparity [18, 66]. However, these factors only partially explain the stark contrast in the importance of CRS on online markets. The most likely cause for our deviating findings is that as our sample is taken from actual sales data whereas the majority of the past studies is based on consumer surveys of claimed purchase intentions which are prone to response biases [23]. This in turn could lead to a stronger presumed correlation of CRS and price tolerance. As a result, building a sustainable CRS remains a worthwhile strategy for differentiation to avoid price competition and achieve higher margins, but its priority in a business context must not be overestimated.

## 6 Limitations and research directions

While all proposed hypotheses in the present research are supported with actual sales data, six main limitations of our study should be kept in mind and overcome in future work.

First, given the price and purchase history data provided by the online retailer, the sample is limited to German online customers who purchase power tools and other electric appliances. Deregatu et al. [24] found that the relative importance of physi-

<sup>4</sup> Customers are increasingly using payment methods, such as *PayPal*, in which they incur a lower risk that the merchant will not deliver the promised service.

cal quality inspection and effectiveness of PCW information differs across product types. As the retailer under study mainly sells non-look-and-feel products in a very competitive market, our research results may not hold for other product types and less competitive environments [60, 68]. For example, the suggested effects of new payment methods, cultural differences, and the difference of look-and-feel versus non-look-and-feel or high-priced versus low-priced products could be investigated. Hence, studies which replicate our findings with other product categories and buyers from other nations are desirable.

Second, the unequal sample sizes in our dataset, ranging from 7,460 data points for new customers to 457 data points for existing customers, is a limitation which could cause statistical bias and affect the generalizability of our results.

Third, the limited observation period of just six months could decrease the reliability and validity of the results. Consequently, additional investigations with longer study periods of several years are desired. They would allow identifying temporary and seasonal effects such as a change in purchasing behavior due to the time of year or other temporal events.

Fourth, we collect only anonymized factual sales data without any connection to other customer characteristics such as age, gender, or risk aversity. Caution is needed when interpreting the effect of PCW on price tolerance. The observed differences between customers who used PCWs and those who did not may be attributed to disparities in customer characteristics rather than the direct impact of PCW usage. Therefore, our sample may suffer from self-selection bias as price-sensitive consumers could be more inclined to use PCW and could be less likely to become repeat buyers. Consequently, PCW users might engage in price comparisons with other retailers even when PCWs are unavailable. To mitigate this, further research is needed to evaluate the causal effect of PCW usage on price tolerance, addressing the potential for selection bias and evaluating the efficacy of the previously discussed strategies for driving organic customer traffic. Similar limitations, albeit to a lesser degree, apply to our findings concerning CRS, which is why we refrain from deriving direct causal implications from our results.

Fifth, future work could explore the effect of various types of PCW on consumer price tolerance. Previous work has found that personal recommendations, for example through a social-shopping community, tend to generate more loyal customers than an acquisition through a meta-search engine [106]. It could be examined whether the customer was directed through a (1) meta-search engine, a (2) comparison website with buying options, or (3) a social-shopping-community, and how this affects their price tolerance.

Sixth, our study only incorporates behavioral loyalty in the sense of repeat purchases. Previous research has shown that attitudinal loyalty [56] and psychological factors such as trust in a seller also play an important role in the formation of price tolerance towards an online retailer [73, 82, 117]. Our research simplifies loyalty as mere repeat purchase behavior. As a consequence, multi-source and -criteria-studies should supplement our work by combining questionnaire responses with actual purchase behaviors in order to better reflect the multi-faceted nature of loyalty [105, 123].

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## Declarations

**Conflict of interest** On behalf of all authors, the corresponding author states that there is no conflict of interest.

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