

# When does price transparency matter? – The case of Amazon

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# When does price transparency matter? – The case of Amazon

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## ABSTRACT

Price comparison sites (shopbots) are supposed to create price transparent markets. Nevertheless, online prices are still very dispersed, making the question when and how customers are influenced by price transparency the key for understanding electronic channels. This study is the first empirical investigation of this question using transaction data from the largest online retailer Amazon and a large price comparison site. Based on a unique dataset of 29,667 price and sales figures for 291 products in three product categories, the impact of competitors' prices on sales is analyzed. We find support for our hypothesis that price comparison is generally more important for the low price products within a product group and less important for the average priced product. Results vary for the highest priced products. The results are translated into practical guidelines for firms trying to optimize their competitive pricing strategy.

## Keywords

Price comparison, search cost, price transparency, shopbot, e-commerce.

## INTRODUCTION

One main driver of price dispersion is the existence of search costs. However, on the Internet, search costs are dramatically decreased (Bakos, 1997). The key enablers is the growing popularity of online price comparison sites (shopbots) which transform the historically sequential character of price search into a binary decision. Price comparison websites are “automated tools that allow customers to search for prices [...] from online retailers at a click of a button” (Smith, 2002). They provide a full overview of market prices. Shopbots have become an important part of e-commerce, with more than 46% of all online users in Germany (KPMG, 2011) and more than 22% in the United States (Compete, 2010) comparing prices on the Internet.

However, price dispersion still occurs on the Internet and it endures (Ancarani and Shankar, 2004; Ba et al., 2011; Brynjolfsson and Smith, 2000; Pan et al., 2004). Accordingly, people seem not always to make use of the price transparency offered to them by shopbots. The question when customers compare prices on the Internet has hardly been studied. Furthermore, the studies covering price dispersion are not focusing on transactions but instead considering only the offers available on the Internet. This can be misleading, since it might overestimate the impact of outliers which are never purchased at this price (Ghose and Yao, 2011). To analyze the impact of transparent markets enabled by shopbots, we have therefore to consider transaction data instead of posted prices.

This study is the first attempt to address this issue by looking at the offers and sales of the largest online retailer in Germany, Amazon.de in relation to the cheapest offerings of its competitors. We investigate how the importance of the price gap between Amazon and the cheapest competitor varies for different products within one product group. A product group is defined as a set or a range of products that fulfill the same purpose delivering different levels of performance, e.g. the product group of television sets, which range from cheap to expensive and thereby have different sizes, image quality, resolution and so on. Thereby, we address the research question “*When do offerings on price comparison sites impact sales?*”

## THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

To set the theoretical ground for our study, we ran a structured literature review on price comparison sites following the methodology by Webster and Watson (2002). The review shows the research gap that we address in this paper. Thereafter, we derive a model of customer's price comparison behavior based on search cost theory, price transparency and price sensitivity.

### Price Comparison Sites

Research has investigated shopbots as an artifact itself or used the available data to make inferences about firms or customers behavior (cf. Table 1). Early price comparison sites have often been biased (Smith, 2002) because shops had to pay to be listed and positioning was negotiable. Today, the revenue model has moved from listing fees to rewards for the transactions

they initiate. The number of vendors they cover is the main quality criterion for matured price comparison sites (Allen and Wu, 2010).

Author	Research Aim / Question	Focus	Sample	Results
Allen and Wu (2010)	How well do shopbots represent online markets?	Shopbots	Books	Size (affiliation) drives a shopbot's market representativeness positively (negatively)
Tang et al. (2010)	What is the impact of shopbots on electronic markets?	Shopbots	(Literature)	A 1% increase in shopbot use is correlated with a \$0.41 decrease in price levels and a 1.1% decrease in price dispersion
Smith (2002)	Impact of shopbot use on prices and price dispersion	Firms	Books	Various strategies to differentiate available
Baye et al. (2004)	Differences in price dispersion dependent on competition	Firms	Consumer electronics	Levels of price dispersion vary systematically with the number of firms listing price quotes
Koçaş and Bohlmann (2008)	What factors apart from loyalty are creating a variety of pricing strategies?	Firms	Books	Retailer's pricing is driven by the ratio of switchers for which the retailer competes to its loyal segment size
Haynes and Thompson (2008)	Influence of market structure on shopbots	Firms	Digital cameras	Robust negative relationship between seller number and price
Smith and Brynjolfsson (2001)	Importance of brand in a market with homogenous goods	Customers	Books	Heavy branded vendors enjoy a price advantage over other retailers
Su (2007)	How important is brand for online shopping?	Customers	Digital camera and book (experiment)	Price, objective product information, and perceptions of retailer credibility are the three important attributes for selection at a shopping bot
Xu and Kim (2008)	How do order effects and other market competitive factors work together to attract consumers' attention to online vendors?	Customers	Consumer electronics and books	The effect of serial position of a vendor in a list is mediated by consumers' attention which in turn affects the probability of the vendor being accepted
Wan et al. (2009)	Does comparison shopping lead to information overload for consumers?	Customers	Digital cameras and PDAs	Use of more than one decision-making tool requires more decision-making effort and results in less decision satisfaction
This paper	Impact of price comparison sites on sales for different product groups and price levels	Customers	Consumer electronics	(see below)

**Table 1. Overview on Empirical Studies on Price Comparison Sites**

The information available on price comparison sites are often used to derive firms' pricing strategies. Price dispersion decreases with the diffusion of price comparison sites (Tang et al., 2010). Competition influences the range of prices offered. The more offers are available for a certain product, the lower the prices and the dispersion between the covered vendors (Baye et al., 2004; Haynes and Thompson, 2008). Sellers try to differentiate their prices because of their superior service,

their brand or their loyal customer base (Koçaş and Bohlmann, 2008; Smith, 2002). Studies investigating not only the firm's pricing strategies but customer behavior confirm price advantages due to brand (Brynjolfsson and Smith, 2000) and reputation (Su, 2007). Also simple ordering effects have been found to be influential for the customer's decision (Xu and Kim, 2008).

Overall, research mainly used consumer electronics and books as examples because price comparison sites are widely used for these types of goods. However, the questions for which products price comparison sites are more important and how the sites affect e-commerce vendors remain open for further research. This paper makes a first step addressing this identified research gap.

### **Search Costs and Price Transparency**

Three different types of search costs can be identified: costs for identifying the right product, the sellers and their prices (Stigler, 1961). We focus on the latter two. The costs are mainly driven by the amount of time the individual buyer spends on searching. The level of these costs is depending on the individual time valuation of the buyer, mainly on income, and therefore on the opportunity cost of spending time with searching. Furthermore, other factors like phone or travel costs can add to the expense of searching. The quantity of price searching is determined by the expected marginal return compared to the individual search costs. As described above, shopbots shrink all of these costs into a single investment of triggering a price search.

One would presume that price dispersion, which can be described as a "measure of ignorance in the market" (Stigler, 1961, p. 214), would therefore decrease online. Price dispersion occurs when at least one of Bertrand's assumptions, product homogeneity, zero search costs, or perfectly informed consumers, is violated. Lower search costs and increased availability of information should thus lead to lower dispersion of Internet prices compared to conventional retailers. But surprisingly, price dispersion is very high with an average of 25% for CDs and 33% for books. Compared to offline channels, this reflects an increased price dispersion for books and approximately equal dispersion for CDs (Brynjolfsson and Smith, 2000). More recent studies confirm both, lower price levels online and higher dispersion ranges (Ancarani and Shankar, 2004; Clay et al., 2002; Lee and Gosain, 2002).

Different possible explanations for the price dispersion have been challenged by previous research. Seeing the Internet as a transitory phenomenon, consumer awareness and thereby price competition should increase over time with price dispersion decreasing concurrently. This trend of decreasing price dispersion was not found within the 8 month period of a study conducted by Baye et al. (2004), observing 4 million prices of 1,000 consumer electronics with a high average price of \$460. These findings also show that shipping costs are not the main reason for price dispersion (Ancarani and Shankar, 2004), since they are only marginal in this price range. Iyer and Pazgal (2003) argue that an increased number of sellers listed in price comparison sites would lower the attractiveness of competing over prices alone and therefore lead to different prices. But even service quality offered can only partly explain the differences in prices (Ba et al., 2011; Pan et al., 2002). Some of the dispersion can be traced back to price differences between multichannel and pure online retailers. Multichannel e-tailers that offer products both online and offline charge higher prices than pure online retailers (Tang and Xing, 2001) and are therefore increasing dispersion in the market (Ancarani and Shankar, 2004).

### **Hypotheses Development**

We argue that parts of the price dispersion can be explained by different price search behaviors for different product price levels. Since customers' price comparison behavior is found to be often overestimated (Urbany et al., 2000), we reason in the following that the high degree of price comparison is only true for certain products within a product group. Although price search is transformed from historically sequential search into a binary decision, the visit of price search websites still requires effort. This effort can be described as fixed cost for retrieving the price comparison table. Additionally, mental costs occur. The additional information available can lead to an information overload. Customers might not be able or willing to process all price information available. Therefore in some cases, customers are willing to pay more for products online (Bailey, 1998; Lal and Sarvary, 1999; Suri et al., 2003). Since the products on the upper end of a product range offer larger absolute savings compared to the cheaper ones, they are more likely to cover the fixed costs and motivate buyers to compare prices. Therefore:

*Hypothesis 1: Competitors' prices are more important for products on the upper end of a product group's price range than for the average priced product.*

This hypothesis is also underpinned by studies of price awareness in the offline sector. Dickson and Sawyer (1990) find in their study carried out in a supermarket that customers are surprisingly often unaware of the price of a certain product that they are buying at the point of sale. Many do not even check prices of alternative products on the same shelf. The study

indicates that customers are simply ignoring rational price search in some situations, especially in settings where prices are low.

Besides the differences in payback for price search, the buyers themselves differ between the products within a product group. The cheapest products within a product group, e.g. the cheapest TV available, is purchased by a different buyer group than the high-end version (Villas-Boas, 1998). Due to the fact that they self-select into the cheapest group, they have either limited financial means or a very low willingness to pay for the product group. Accordingly, customers with less developed product preferences are found to be more price sensitive (Papatla, 1996) and therefore have a higher intention to use price comparison sites. Therefore:

*Hypothesis 2: Competitors' prices are more important for products on the lower end of a product group's price range than for the average priced product.*

Both hypotheses together suggest a U-shaped relationship between the price level of a product within a product group and the importance of the competitors' offerings.

## EMPIRICAL ANALYSIS

### Dataset and Descriptive Results

The dataset consists of price and sales figures from the largest online retailer Amazon. The data has been collected for 291 products in three product groups over a two month timeframe between November 2011 and January 2012 in Germany. The study focusses on fast moving consumer electronics, which have been in focus on online pricing literature<sup>1</sup>. The products within the product categories have been selected due to their general popularity on a third party website to ensure an appropriate level of competition and sales during the period of investigation. However, it was important that the selection criteria were independent from the popularity of the product on Amazon itself to prevent a selection bias, since popularity of products on Amazon might be caused by special offers. Data has been recorded on an hourly basis, enabling us to build on more than one million data points. The data from Amazon has been enhanced by market prices delivered by Geizhals.de, a leading price comparison site, which represents the overall online market for consumer electronics very well according to the criteria identified by Allan and Wu (2010). Data was recorded continuously such that every change in the cheapest price was detected with the exact time of the price change. Several control variables such as availabilities, review valence, number of reviews and others have been recorded as well.

The Amazon sales rank is used to approximate the sales of the product. This method is well established to investigate sales and customer's reactions to prices (cf. Brynjolfsson et al., 2003; Chevalier and Goolsbee, 2003; Ellison and Ellison, 2009; Forman et al., 2008; Ghose et al., 2006). The sales rank is updated hourly based on the sales of the product within its category. Thereby a numerically lower sales rank indicates higher sales. While Amazon does not charge any shipping costs for products above €20 (true for all but one product in our sample), we incorporated the cheapest available shipping option into the product price for products offered by the competitors. Therefore, the full price is the basis for comparison.

Although data has been recorded every hour, we decided to use only every 12th record, as price changes were not that frequent and changes in price need some time to affect sales. Therefore, the analyzed dataset consists of two observations per product per day. The study focusses on three product categories: television sets, portable entertainment and washing machines. All three are product groups available in almost every household with televisions and portable entertainment (portable music and video players) being very popular for online shopping. The third category, washing machines, is rather exceptional for distance selling due to its size and weight, providing a higher variety in our study. Between 95 and 99 products have been watched in every product category, leading to 9,633 to 10,250 observations per product category. Our study also revealed infrequent price errors on both, the price comparison site as well as on Amazon. In these cases, prices jumped by large dimensions for a short period before they were corrected, e.g. leading to a washing machine being sold for €49.90 instead of €499.00. The vendors cancel orders placed at error prices. Therefore, we controlled for these unrealistic price changes in our dataset. An overview on the key variables is displayed in Table 2.

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<sup>1</sup> The second product type that has been widely investigated is books. However, due to specific laws, prices for books in Germany may not vary. Thus, books were not used in this study as a product category.

<b>Television sets, N=99</b>	Observations	Mean	Std. Dev.	Min	Max
Log of sales rank	10250	7.64	1.62	1.61	12.39
Amazon retail price	10250	886.27	972.57	249.00	7999.97
Cheapest retail price	10250	813.87	938.87	49.62	7899.00
Average review valence	9927	4.32	.38	1	5
Number of reviews	9927	41.20	34.88	1	145
<b>Portable entertainment, N=97</b>	Observations	Mean	Std. Dev.	Min	Max
Log of sales rank	9633	7.61	1.85	1.79	12.27
Amazon retail price	9633	104.82	85.96	14.99	392.98
Cheapest retail price	9633	91.34	76.92	14.99	361.53
Average review valence	9185	3.78	.60	1	5
Number of reviews	9185	71.12	92.33	1	375
<b>Washing machines, N=95</b>	Observations	Mean	Std. Dev.	Min	Max
Log of sales rank	9784	6.31	1.63	.69	8.95
Amazon retail price	9784	510.93	154.68	180.12	1199.90
Cheapest retail price	9784	423.24	128.71	180.12	935.00
Average review valence	6582	4.30	.85	1	5
Number of reviews	6582	18.74	33.14	1	188

Table 2. Descriptive Statistics

### Data Analysis

To analyze the impact of the prices on sales, ANOVAs were performed. Our dataset consists of two price and sales records per product per day. Previous studies defined the sales rank as a function of a product specific fixed effect as well as other factors that might influence the sales (Chevalier and Goolsbee, 2003). The dependent variable is  $\ln(\text{salesrank})$  of product  $k$  at time  $t$ . Since the sales of a product depend on many other factors besides price, we expect rather small explanation of the overall sales variance from the price fluctuation. However, the interpretation of the differences within our large dataset is sufficient to answer our research question. Since the sales ranks of the different product groups are independent from each other and sales frequencies between the groups differ, the effects of sales between the groups cannot be compared within a single analysis. A group specific analysis was chosen to take this into consideration. Five price levels for portable entertainment and washing machines of similar range and size are defined to analyze differences between price levels within a product group. Due to the larger price range for televisions, seven price levels are defined to account for the different price levels. The following equation was solved for every product group and price level

$$\ln(\text{salesRank})_{tk} = \alpha + \beta_1 * \ln(\text{amazonPrice}) + \beta_2 * \ln(\text{cheapestPrice}) + \Omega'X_{tk} + \mu_k + \varepsilon_{tk}$$

where  $\alpha$  is a general sales rank adjustment,  $\mu$  accounts for product specific differences in sales rank and  $X$  is the vector of the control variables. The control variables include the number of reviews, the review valence and variables to account for differences in delivery times for Amazon as well as the cheapest competitor. Results for the effects of the two variables *amazonPrice* and *cheapestPrice* are displayed in Table 3.

Product group	Price levels	Amazon Price		Cheapest Competitive Price	
		Univariate F Value	Partial Eta Squared	Univariate F Value	Partial Eta Squared
Television sets	Price Level 1 (< 300€)	161,2***	0,314	16,6***	0,045
	Price Level 2 (300-500€)	532,8***	0,190	0,009	0,00
	Price Level 3 (501-700€)	397,3***	0,111	0,116	0,00
	Price Level 4 (701-900€)	66,9***	0,035	0,0013	0,00
	Price Level 5 (901-1100€)	81,9***	0,131	6,3*	0,012
	Price Level 6 (1100-1300€)	161,5***	0,184	12,6***	0,017
	Price Level 7 (> 1300)	31,5***	0,031	9,9**	0,010
Portable entertainment	Price Level 1 (< 50€)	100,5***	0,027	20,5***	0,006
	Price Level 2 (51-100€)	63,4***	0,037	4,2*	0,003
	Price Level 3 (101-200€)	330,9***	0,120	2,5	0,001
	Price Level 4 (201-300€)	223,3***	0,184	0,3	0,00
	Price Level 5 (>301€)	4,1*	0,011	6,2*	0,016
Washing machines	Price Level 1 (< 400€)	705,1***	0,247	10,5***	0,005
	Price Level 2 (401-500€)	646,9***	0,273	47,9***	0,027
	Price Level 3 (501-600€)	66,3***	0,046	1,9	0,001
	Price Level 4 (601-700€)	41,9***	0,068	2,6	0,005
	Price Level 5 (>701€)	9,2**	0,014	0,6	0,001

**Table 3. Effects of Amazon Price and Cheapest Competitor Price on Amazon Sales for Different Product Groups and Price Levels**

(\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ )

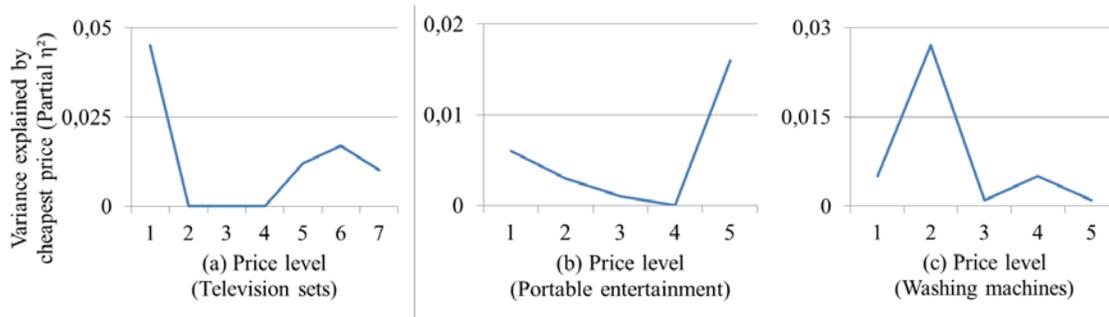
## Discussion

As expected, the data analysis indicates a strong and significant effect of the Amazon price for every product group and price level (cf. column 3 in Table 3), meaning that sales decrease with increased prices. We are particularly interested in the effect of the cheapest competitive price. Figure 1 illustrates the strength of the impact for the different product groups and price levels. For television sets, the differences in effect sizes for price levels 5-7 are significantly higher than for the average price levels 3-4. Therefore Hypothesis 1 is supported. However, the strength of the effect decreases slightly for price level 7 (cf. column 5 in Table 3). Possible explanations for this deviation are discussed in the following paragraph. Regarding Hypothesis 2, competitive prices have a very strong effect on sales of products at the lowest price level. Interestingly, the data shows almost no effect for the price range between €300 and €900. For the portable electronics, the effect size curve follows a U-shape as predicted by Hypotheses 1 and 2. The differences at the lower and at the higher end of the price range are significant, with stronger effects at the upper end. However, the relatively low effect size of the Amazon price on level 5 indicates that another effect superimposes the price impact for high priced portable entertainment products. A possible reason could be that Amazon does only infrequently sell music and video players priced above €300. For washing machines, Hypothesis 2 is supported with the effect being significantly stronger for price levels 1-2 compared to price level 3. The cheapest price is of high importance for low priced washing machines. However, the results for Hypothesis 1, the higher price levels, are not significant.

How can the derivation from Hypothesis 1 in the product group washing machines and partly for television sets be explained? As indicated in the dataset description, washing machines are rather inconvenient products for the online purchase. Due to their weight and size, they can only be delivered by haulage firms. When looking deeper at the different price classes for television sets, we see that price and size are, in contrast to the other product groups, strongly correlated. The television sets in the price range between €1,300 and €3,000 mostly have huge screen sizes. These products are very difficult to move and to return, therefore, when investing in the more expensive products available, service plays a more important

role than for portable electronics or small TVs. Amazon delivers such an above average customer service. This effect might overrule Hypothesis 1 for some product types.

Such alternative explanations cannot be ruled out using the current dataset. The major limitation of this study is the fact that no characteristics of the other vendors are incorporated. The differentiation between offerings by high quality or low quality competitors could be used to identify even stronger effects and would complement previous research discussing the role of risk in e-commerce (Kim et al., 2009). Furthermore, the distribution of the market prices is not taken into account. The distinction whether one or many vendors offer cheaper prices would also be helpful to derive more precise results. However, despite this potential for further investigations, we already derived significant results on our level of analysis. The deeper analysis would not alter the results but instead allow us to draw a more elaborate picture of the relationships.



**Figure 1. Illustration of the Effect Size of the Cheapest Competitive Price in the Market on Amazon Sales by Price Level for (a) Television Sets, (b) Portable Entertainment, (c) Washing Machines**

## CONCLUSION

The aim of the study was to investigate, when competitors' prices listed on price comparison sites play an important role for sales. The study was the first to investigate the impact of price comparison websites on a particular seller empirically. We analyzed the research question using a unique set of Amazon data enriched by competitors' prices from a price comparison site consisting of nearly 30,000 price observations for three product groups. We find evidence for our theoretical hypotheses that within each product group, the importance of competitors' prices differs between price classes. The hypothesis that the price search sites and therefore competitors' prices play a strong role for the purchase decision of low priced products is supported for all three product groups. For the medium priced products within a product group, the competitors' prices only play a secondary role. Results are mixed for the high priced products within a group, probably due to varying product characteristics.

The findings also have important implications for managers. Since many online retailers might not be able to compete via price for every product, it is particularly important to watch competitors' prices for the low price products within a product group. However, there is notable space for price premiums for high quality vendors like Amazon in the middle segment. The study suggests that the high priced products within a product group are also more prone for price comparison. However, results between the product categories differ. Therefore, we call for studies continuing to investigate the impact of price comparison sites empirically. In the next steps, more product groups and controlling for products' properties could gain further insight regarding higher priced products.

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