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**Tuning an Online Shop:
Consumer Reactions to E-tailers' Service Quality**

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Tuning an Online Shop: Consumer Reactions to E-tailers' Service Quality

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Abstract

This paper investigates the impact of service quality in e-tailing on site visits and consumer demand (approximated by the last-click-through concept). We use a large representative data set obtained from a price-comparison site which covers most of the national (Austrian) market on e-tailing. Customers' valuations for a broad range of 15 different service characteristics are condensed by factor analysis. Negative binomial regressions analysis is used to measure the impact of principal factors for service quality on referral requests to online shops and last-click-throughs for different product categories.

JEL Classifications: M31, L81, L25.

Keywords: e-commerce, price comparison, horizontal service differentiation.

1 Introduction

Online stores have an increasing market share in specific parts of retailing, in particular consumer electronics and other hi-tech articles. Due to the proliferation of price-comparison sites or shopbots, price competition is very fierce. This gives a larger role to non-price marketing which can consist of pre-and post-sale services in a general sense. While there is a large literature on marketing-mix in brick-and-mortar stores (for a survey see Constantinides (2006)), contributions on e-tailing are scarce. We offer a first comprehensive study of quantitative impacts of different service characteristics in e-tailing by using click-data from a large Austrian price search engine (www.geizhals.at).[1]

A naive point of view postulated the end of price dispersion on the internet: today prices in online shops differ still widely; sometimes online price dispersion is no narrower than off-line (Brynjolfsson and Smith (2000) or Clemons, Hann and Hill (2002)).[2] Reasons for the existence of this price dispersion are manifold: (i) Already Carlson and McAfee (1983) or Stigler (1991) discuss search cost of customers between the various offering firms and show that a positive price dispersion can be an equilibrium where marginal cost of an additional search is equal to the marginal gain.[3] Even though the internet should reduce search cost significantly these cost will not completely vanish: Due to the plenitude of obfuscation strategies (e. g. low prices and high shipping cost, availability tricks, ... see Ellison and Ellison (2009)) the true nature of the price structure is often difficult to decipher. (ii) Fishman (1992) argues that menu cost might result in staggered prices and therefore price dispersion. Of course, there is the counter argument that especially on online markets menu cost is particularly low. Even if physical cost of changing price tags is negligible, still managerial decision cost to strategically adapt to the price policy of competitors cannot be neglected. (iii) Profit maximizing price discrimination of firms could also be responsible for the price dispersion of a homogeneous good. In Clemons, Hann and Hill (2002) different degrees of information result in price discrimination of consumers whose nature is established as price dispersion.

Further reasons why prices are not completely equal on the internet (or why

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[1]The German word 'Geizhals' means 'niggard' or 'penny pincher'.

[2]See Pan et al. (2004) for a survey on price dispersion on the internet.

[3]Burdett and Judd (1983), Burdett and Coles (1997), and Salop and Stiglitz (1982) provide additional arguments where search cost hinders consumers in equilibrium to find the lowest price.

consumers do not shop exclusively at the cheapest shop) are uncertainty about the quality, style and fit of a product and worries about security and reliability of the vendor. Price comparison sites - as they allow searching for vendors of exactly identical (homogeneous) goods - do away with product uncertainty; still concerns about trust, payment and delivery as well as post-shopping service including grievance procedures or redemption policies are important.

For the case of offline retailing Homburg et al. (2002) present a comprehensive study on dimensions and determinants of service orientation as a part of a retailer's business strategy as well as its impact on profitability of retailers in clothing and furniture sectors. This paper analyzes the relevance of service differentiation as one reason for price heterogeneity in online markets.

For the online sector, Zeithaml et al. (2002) define service as comprehensive pre- and post-Web site aspects, stressing in particular information availability, ease of use, security/privacy and fulfillment/reliability as defining aspects. Kalyanam and McIntyre (2002), Bauer et al. (2006), Parasuraman et al. (2005) and Wolfinbarger and Gilly (2003) also categorize service quality in an e-marketing mix. Most empirical studies on the impact of dimensions of service quality in online markets rely on surveys or experiments and hardly use realized click-data. Bauer et al. (2006) as well as Wolfinbarger and Gilly (2003) use a structured survey to assess the impact of service quality on satisfaction with the e-tailer and repurchase intentions.[4]

Trust in and reputation of web-sites are particularly important service categories which should apply in particular to shopping with the help of a price-comparison site. Bart et al. (2005) analyze a large survey of over 6000 respondents and find that determinants of online trust are different across site categories and consumers. While privacy and order fulfillment are found to be most important for travel sites navigation, advice, and again order fulfillment are most important for e-tailing. Schlosser et al. (2006) use an experimental approach to investigate the impact of web site design on trust and purchase intentions and find that higher investment in web design is important for establishing trust both for unknown as well as for already well-known firms.

To our knowledge, our study is the first to systematically investigate the im-

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[4]See also Blake et al. (2005) and Oh et al. (2008) for survey studies on web-site features like site design and innovativeness on consumer patronage of experienced and initial shoppers.

pact of service quality in e-tailing on site visits and consumer demand. We use
a large representative data set obtained directly from a price-comparison site
which is covering most of the national (Austrian) market on e-tailing. These
data allow to look at a broad range of 15 different service characteristics like
accessibility, assortment, information and advice, convenience of the web site,
reliability of the order fulfillment, and delivery modalities which are given by
past shoppers' evaluations. By observing referral requests to the e-tailer's web-
site we can in a first step determine the number of vendors in the consideration
set of the shopper (Hauser and Wernerfelt (1990)). While referral rates are
important as a measure of attention the shop gets from potential buyers, they
do not tell us a lot about actual purchases. Using the concept of a last-click-
through (e.g. Smith and Brynjolfsson (2001) or Bai (2004)) we can further
narrow down shop visits to an actual buying decision.

Our results are important as the significance of service orientation and service
quality in e-commerce is shown. As different service characteristics might have
different impacts for distinct product categories (e. g. refrigerators versus
USB-sticks) it is important to measure these effects for different branches of
online stores. From a marketing perspective these results allow the design of
an optimal marketing mix where the retailer's individual cost structure for
services can be brought in correspondence with their impact on markets in
the form of customer's attention (click data) and demand (last-click-through
data).

The paper is organized as follows: Section 2 presents the theoretical framework
for product differentiation as one source of price dispersion. Whereas section
3 discusses the data, section 4 comes up with our empirical results. Section 5
summarizes the paper with managerial conclusion.

2   Theoretical background

Following Lancaster (1966) and Rosen (1974) the utility function of a rep-
resentative consumer can be written as $U(q, s^{hv})$. In this utility function q
represents the quantity of a homogenous good which is traded on the markets.
The variable s^{hv} refers to the services which are generated by the retailer.
Since products can only be bought via retailers the choice for a certain retailer
is essentially also a choice of the retailers' services. If we take account of this

inseparable connection between services and product we can argue in a model of vertical and horizontal product/service differentiation:

E-commerce retailers are *horizontally* distinguished from each other via the type of services offered (e. g. simplicity of navigation on the website, validity of online information, delivery time, packing and content of consignment, ...). Whereas some consumers have a strong preference for a short delivery time other consumers might estimate the broad assortment of the offered product mix. Additionally retailers may choose different quality standards for their services in the sense of vertical product/service differentiation. One firm might emphasize the service quality after shipment; another firm regards the possibility of tracing the shipment by consumers as highly important. Retailers have the possibility to influence the *vertical* dimension of services by changing the quality of the different types of services. The combination of possible horizontal and vertical product/service differentiations results in a two dimensional matrix of retailers' service characteristics which are abbreviated in our utility function as s^{hv}.

A broadening of the types of services (horizontal differentiation) and improved quality standards for these services (vertical differentiation) will increase the retailers' cost. Given the cost structure of services the utility maximizing behavior of consumers will result in a direct hedonic price function $p_j = p_j(q_j, s_j^{hv})$ where the price for the homogenous good of the retailer j is determined by the quantity q and the characteristics of the offered services s^{hv} by retailer j. Assuming identical wholesale prices for all retailers the product differentiation approach claims a stable relationship between the traded quantities per retailer, the retailer prices and the retailers' service characteristics. The direct hedonic price function can also be transformed into an indirect hedonic price function with quantity as the dependent variable: $q_j = p_j(p_j, s_j^{hv})$ which will be used in our econometric analysis further on.

3   Data and Estimation Strategy

Data: For our empirical analysis we use the database of http://www.geizhals.at. This web-site is a 'price search engine' which collects the price offers via standardized protocols from a predefined group of sellers and presents them electronically via its web-platform. Geizhals.at has contracts with several hundred

retailers which can list their price offerings for a total of about 370000 products on the Geizhals.at website. Customers can evaluate the service provided by the retailers online.

Due to computational limitations we have to restrict our data to an arbitrary week in 2008. Since prices can be updated from the sellers about 10 times a day we have calculated weighted price offers per product and seller over this time period. The data used in this analysis include price offers for 37348 products from a total of 449 sellers with 32615 customers' quality evaluations of products and sellers. Furthermore the data comprise detailed information on 526144 customer clicks to retail shops together with the respective views and filter options of the customers.

From sellers' price offers we know the exact name of the product and the producer together with the products' mapping into a hierarchical classification system for the products (categories, subcategories, and subsubcategories). Furthermore, sellers' price offers include information on availability and shipping charges. From the customers' clicks we know the product and the retail shop where the customer wants to be referred to.

In the context of our analysis we will measure the retailers' horizontal and vertical service differentiation s_j^{hv} by customers' evaluations of the different service characteristics with grades between 1 (=very satisfying) and 5 (=very unsatisfying) and the option of 'don't know' for any of the following criteria: navigation on the site, assortment, availability, service, price level, shipping cost, product information, payment modalities, terms of business, website-performance, satisfaction with the handling of the offer (order transaction, validity of information, confirmation of order and tracing of shipment, delivery time, packing and content of consignment, service after the shipment). Since the posting of an evaluation requires the registration at the Geizhals website customers' retailer evaluations are considered by other consumers as sufficiently reliable. Moreover, Geizhals.at makes a special effort to purify these customer comments because its business model relies crucially on the reliability of its data. Customers interested in querying retailers' valuations have three possibilities to do that: (i) The average grade of the valuations of all customers with regard to all criteria can be seen next to the retailers' price offers. (ii) Customers can also query the average ratings with respect to single service criteria. (iii) Finally they can inspect each single customer

valuation in addition to individual comments the customers can give together with the evaluation. In our dataset we can control for the fact that some of the consumers are interested in a detailed evaluation of the retailers' different service characteristics and others are only looking at an overall evaluation.

Estimation Strategy: Econometrically the above mentioned indirect hedonic price function can be interpreted in the following way:

$$q_{ij} = a_0 + a_1 * Rel.\,Price_{ij} + a_2 * s_j^{hv} + \sum_k b_k * X_{kij} + a_{4i} * Product_i + \epsilon_{ij}$$

In this equation q_{ij} is measured by the consumers' clicks on the 'Geizhals'-website on a link to retailer j for product i (referral requests). The variable $Rel.\,Price$ measures the price of product i of retailer j relative to the average price of product i over all retailers j (hence $Rel.\,Price_{ij} = \frac{p_{ij}}{\sum_{j=1}^{N} p_{ij}/N})$[5]. Horizontal and vertical product/services provision is addressed with the variable s_j^{hv}. In the econometric analysis we are using the average of customer valuations of all the above mentioned individual service criteria as well as a measure based on a factor analysis to be discussed below. Additional control variables X include: *Rel. Shipping Cost* which were calculated from the information given at Geizhals.at. *Germany* is equal to 1 if the online shop is located in Germany, Austria otherwise. *Avail* is equal to 1 if the product is deliverable at short notice, *Pickup* is equal to 1 if the retailer has a pick up store. *Pricelevel* denotes the average relative price of all other goods offered by the retailer. *#Evaluations* counts the number of customers who have given an evaluation of the retailers' service characteristics. *#Inspections* numerates the number of customers who actually had a look at the detailed evaluations of service characteristics. The dummy variables $Product_i$ allow the calculation of fixed effects for the different products. Descriptives for the used variables can be found in Table 1.

The dataset is characterized by a high amount of zeros in the regressand: 91 percent of all product offers across the retailers are never selected from the customers either because of the high price or the bad valuation of the retailer. Since the regressand represents a typical non negative count variable we are using negative binomial panel estimations.[6]

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[5]Since a retailer can change the prices up to 10 times a day we are using the retailers average price over the observation period.

[6]In all our models the likelihood ratio test for overdispersion rejects the poisson model.

4 Empirical Results

The main interest of this paper lies in the identification of relevant service characteristics of online shops. However, a regression analysis including all 15 different service characteristics directly is not appropriate due to the high multicollinearity between the regressors. Table 2 lists the correlation coefficients for the different customers' evaluations of the retailers' service characteristics.

4.1 Factor Analysis

To transform the number of highly correlated variables into fewer unobserved variables we use factor analysis whereby an underlying unobserved variable (called factor) is constructed as a linear combination of the observed ones. In the following we are excluding the customers' valuation for the price as *Rel. Price* and the *Price level* capture this attribute in a more direct way. Since we want to identify main categories which can be built of the fourteen different characteristics the method of 'Principal Factor Analysis' has been applied (see Backhaus et al. (2008) or Basilevsky (1994)). As far as the number of underlying factors is concerned the literature offers various methods with partly different results. According to the 'Kaiser-Criteria' the optimal number of factors should be determined by the number of eigenvalues higher than one.[7] For our data this 'Kaiser-Criteria' would lead to the unsatisfying situation of only one principal factor. Also the 'Scree Test' searching for a sharp change of the first differences of the eigenvalues indicates that only one factor should be used. A third approach to find the optimal number of factors – preserving as much information as possible in the potential factors – is to extend the number of factors until 95 percent of the variance can be explained. Although this method would be reasonable in our case the resulting seven different principal factors for this method were unfortunately difficult to interpret since some of the factors describe very similar service characteristics. Therefore, we have decided for the fourth way to choose the number of factors with respect to the topical interpretation of the reduced set of variables.

Table 3 shows the rotated factor loadings of the different service characteris-

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[7]Eigenvalues are estimated as the sum of the squared factor scores of one factor on all variables and measure how much variance of the observation values is explained by that factor.

tics based on a principal component analysis with orthogonal varimax rotation which leads to five distinct factors. Factor loadings below 0.4 are usually considered as low and have little contribution to the principal factor (in the table factor loadings above 0.49 are printed bold). The last column 'Uniqueness' is the proportion of variance of the variable (e.g. Navigation) that is not accounted for by all of the factors used. It should be noted that our chosen principal factors explain in 13 out of 14 cases a communality (calculated as one minus uniqueness) of more than 90 percent of the original variance in the service characteristics. Only for Packing we have a lower communality of 88.7%.

The following reduced set of variables can be calculated as linear predictions of the rotated factor loadings: The first factor *Order* comprises all relevant aspects for the actual business transaction of ordering and product delivery: Besides the retailers' service quality before and after the purchase, aspects like choice options, shipping cost, validity of information, assortment[8], order confirmation and package tracking as well as delivery time and packing influence substantially this unobserved variable. Looking at the factor loadings it turns out that especially the delivery times as well as individuals' information needs (correctness of information and feedback on the order and the shipment process) are the driving forces behind this factor. Functional aspects of the retailer's web site like convenience of navigation and again the offered product information are highly correlated with the second factor *Web Presence*. Assortment and the website performance are also influential but at a lower degree. Legal conditions like terms of business and overall terms of payment load up to the third factor *Payment*. Interestingly, consumers associate also the satisfaction with shipping cost with this factor. Apparently shipping cost is perceived as an important indicator for a proper legal context as well as a quality indicator in the ordering process. *Service* orientation is also an important area: Service before and after the transaction as well as Terms of Business including for instance warranty conditions contribute to this factor with factor loadings above 0.5. Finally the factor *Net performance* turns out to be important - especially speed of the website and the response rate of the web-server

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[8]In the following we will show a positive influence of this principal factor *Order* on the demand for the product offers of an online shop. However, although larger assortment is generally found to increase store patronage in brick-and-mortar stores (Briesch et al. (2008)), studies for internet grocers found also a significant negative relation between assortment size and category sales (Boatwright and Nunes (2001)).

are decisive criteria for customer satisfaction.

4.2 The impact of service characteristics on online demand

Impact on referral requests: Table 4 shows results for our negative binomial regressions. We show marginal effects of the relative price, some other control variables, and two ways to measure service quality for an online shop: whereas the first column includes the overall measure of retailers' quality calculated by the average over all different service characteristics, the second column uses the more detailed principal factors from our factor analysis. In the first two columns the number of referral requests from the geizhals.at site to the retailer's shop is used as dependent count variable.

Due to the large number of observations all variables are significantly estimated and almost all have the expected sign. If we start with the first column we see that perceived service quality has an important influence on the number of referral requests. Not surprisingly the relative price of an offer is the most important variable: An increase of the relative price by 10% would decrease demand by -0.1354 clicks which is considerable given a mean of 0.62 clicks per period. However, it should be noted that the perceived service quality is also a very important variable. A decline in service quality by one of five possible grades reduces the demand by an amount of 0.055 referral request. This effect is considerable as it represents 8.9% of average demand. Other firm-specific characteristics corroborate theoretical predictions: Shops located in Germany attract considerably less demand from Austrian customers. Presumably, customers fear warranty or delivery problems across borders. Immediately available product offers or offers with additional pick-up possibility - the online shop is part of a brick-and-mortar store - indicate high referral requests.

The effect of shipping cost is surprising at first sight: relative shipping cost has a small positive effect on demand. However, this result is consistent with the successful working of obfuscation strategies in online markets: Attract the customers with low product prices and make profits with high shipping cost or more expensive complements.[9] It seems that customers only start looking

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[9]See also Hamilton and Srivastava (2008) for an analysis of price partitioning on the internet with examples of price and shipping cost.

at shipping cost once they get more serious about buying from the shop.[10] Shipping cost enters the regressions indirectly as the customers' quality judgment of shipping cost enters the factor analysis and directly via 'Rel. Shipping Cost'): The quality judgment focuses not only on the amount of shipping cost but comprises more generally the broad concept of dispatch options. The amount of shipping cost is the only variable which we have to parse from a text field. Therefore, some 10% of the missing cases are coded with the mean of the shipping cost. In the empirical analysis these missing cases are accounted for with a missing flag variable. The restricted quality of the shipping cost is also partly be compensated by including the customers' quality judgment. With 0.04 the correlation between shipping cost and the customers' valuation of shipping options is very low so that multicollinearity should not be a problem.

The firm-specific general price level representing the average relative price of all other goods offered by the respective retailer enters the demand curve as expected significantly negative. Retailers with a reputation of relatively low prices attract more consumers, a result which is quite remarkable in transparent online market. The number of firm evaluations has a positive effect on demand, because customers might trust the reliability of the shop itself and also the evaluations of the shop to a larger extent. Similarly, the number of inspections of the retailers' quality evaluations act as an indicator for the attractiveness of an online shop. It should be noted that the results concerning these control variables are robust across all estimations with different dependent variables.

Instead of the overall measure for service quality 'Firm Evaluation' the second column uses the more disaggregated principal factors. It turns out that the factor *Payment* summarizing legal conditions like terms of business and terms of payment (the option to pay with credit cards, transferal, ...) together with the firms' dealing with shipping cost is the most important service characteristic. Particularly in online shops, where personal knowledge of the seller is absent, legal conditions related to the seriousness of the retailer's business practice are decisive factors. The second most important principal factors are *Net-Performance* (mainly the speed of the retailer's website) as well as

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[10]We measure a negative - albeit low - correlation of -0.05 between the relative price and the relative shipping cost. This low figure is not surprising if one bears in mind that the size of the shipping cost typically represents only a fraction of the product price - hence the possibilities for shipping cost based obfuscation strategies are limited.

the *Web Presence* in general (convenience of navigation, assortment, offered product information) which have quite similar impacts in our regressions. As far as referral requests are concerned conditions around the ordering process play a significant but subordinate role. The factor *Service* mainly consisting of quality evaluations of the service before buy (e.g. quality of the retailers helpdesk) and the terms of business has a relatively small but unexpected positive influence.

Impact on purchase clicks (last-click-throughs): So far we discussed the influence of service characteristics on referral request. Unfortunately, the actual act of purchasing a product is unknown, because actual purchases happen at the e-tailer's own web site, which is unobservable for Geizhals.at and thus for us. In the literature, the concept of 'last-click-through' (LCT) is used as a proxy for the purchasing decision (e.g. Smith and Brynjolfsson (2001) or Bai (2004)). If a customer is searching for a product, she might meander around different web sites, comparing characteristics of the shops, but she will finally settle for the preferred shop and buy there online. The last click to a shop selling the product is usually identified as the click with the highest purchase probability.

In practice, the determination of the 'last-click-through' is aggravated because buyers can shop for a specific product several times in a particular time interval. Analyzing the click behavior of a customer over time we have to define a 'search period' which is finished with an actual purchasing decision. If the customer searches for several days, say, then interrupts the search for a month or so, and reappears again, we might have the situation that a consumer buys more than one specific item at different points in time. Two approaches can be chosen to identify such different search periods. By hierarchical clustering which sequentially adds the clicks with respect to their minimal temporal distance we get a dendrogramm in which the fixing of a hierarchical level results in a certain amount of search intervals. Choosing a low level results in many search spells, choosing a high level gives us fewer intervals. Since the definition of the hierarchical level is arbitrary we decided to find the different search intervals with the Grubbs' Test for Outlier Detection. By choosing a significance level of 95% those especially long time differences can be found out which are distinguishing different search intervals[11]. Since by definition a search requires

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[11]It can be shown that for each level in the hierarchical clustering a certain significance

the comparison of several alternatives even a search period of one hour would have outliers. Hence, we have to introduce additionally some minimal requirements - the sequence of clicks is divided into several search spells if there is a time interval of one week without clicks and the resulting search periods contain at least 3 clicks; in a second version a maximal interspace of one month and a minimal amount of 5 clicks is required.

To complicate matters even more, customers might not only search for one specific product, they might look at substitutes during their search as well. The hierarchical mapping of the products into subsubcategories, subcategories and categories in the Geizhals.at data allows to cope with this issue since this classification scheme just describes the degree of substitutional relationship between the products (products in a subsubcategory are close substitutes, products in categories reflect a looser substitutional relationship between products). Hence, the consumers' different search spells can be analyzed at the level of products, subsubcategories, and subcategories[12].

Given these possibilities we come up with four different measures for the identification of actual purchase clicks indicating the length of the presumed search period[13], and the substitutional relationship of search products: columns three to six in Table 4 show marginal effects of our firm-specific variables for the dependent variables: 'LCT-product-month', 'LCT-product-week', 'LCT-subsubcat-month', 'LCT subsubcat-week'.

The results from the LCT-regressions are very consistent across the different definitions of a LCT. In general all aspects of reliability and quality of the e-tailer get more important in actual purchasing decision. As expected the relative price and the availability of the product offer gets more important if we reduce our analysis to referral clicks with a higher purchase probability. The homeward bias of Austrian consumers increases in case of actual purchases. Although consumers inform themselves in Germany they buy with significantly higher probabilities in web-shops in their home country. As expected shops

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level for the Grubbs' Test for Outlier Detection can be found which results in identical search spells.

[12]In total 358 subsubcategories and 40 subcategories are given. As an example the category 'Video/Photo/TV' contains the subcategory 'TV-Sets' and the subsubcategory 'LCD TV sets with 30-39 inches'.

[13]We do not report the estimates for the subcategorial level since some of the subcategories are conceptualized rather broadly (e. g. the subcategorie 'input device' comprising keyboards, mouses or gamepads).

with a reputation of low prices lose some of their advantage if it comes to actual purchases.

The usage of LCTs as dependent variables shifts also the importance of the service characteristics. Whereas the coefficient for *Net Performance* stays constant and *Web Presence* increases only slightly, the importance of *Payment* and *Order* related service characteristics rise almost twofold. As far as product purchases are concerned we again observe the factor *Payment* as the most important one equally followed by *Order*, *Web Presence*, and *Net Performance*. Although remaining statistically significant the already low influence of the factor *Service* decreases even more.[14]

4.3 The importance of service in different markets

Impact on referral requests: In e-commerce we observe online shops specialized in a certain branch of products (e. g. web shops specialized in the video and photo business) as well as general stores with a very broad assortment of products. In Table 5 and 6 we present the results for specific product categories: 'Audio/Hifi', 'Games', 'Hardware', 'Household articles', 'Software', and 'Video/Photo/TV'. Whereas Table 5 uses referral clicks as dependent variable Table 6 employs the 'LCT-product-month' construct. Results for aggregated firm evaluations are shown in Panel A, marginal effects of disaggregated principal factors are included in Panel B.

Looking at the results in Table 5 we see the broad lines of our argumentation from above confirmed. On an aggregate level, firm evaluation is important for all markets, with the highest impact for Household appliances. Looking at different service characteristics in detail in Panel B we see that *Payment* and *Web Presence* are the most important service characteristics, *Web Presence* being important in particular for 'Games', 'Household', and 'Software'. One might hypothesize that consumers with closer affinities to programming and information technology in general cannot so easily be influenced by the (perhaps specious) professional design of a web-site performance as compared to

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[14]If we compare our results with the importance of non-price categories on retail shopping in brick and mortar stores, a recent meta-analysis by Pan and Zinkhan (2006) shows that selection of products has the highest correlation with store choice, followed by service, quality, store atmosphere, and location. Some of these aspects are not relevant for e-tailing where the same product is offered.

people buying more classical consumer products.

The purchase related factor *Order* delivers mixed results, only driving demand in the categories 'Hardware', 'Household', and 'Software', while the factor *Service* is only important for Household appliances. The reason for the relatively high importance of all quality factors in the 'Hardware' category might find its explanation in the history of the price search engine: Originally geizhals.at was a platform to inform about IT related hardware. Other product categories like household products entered the price search engine only in the recent past. For that reason quality and reliability characteristics in this newly entered branch might be of special importance.

As far as the other firm specific variables are concerned we observe a significantly higher effect of the relative price and country of origin in the demand for household products. Whereas availability of products and the number of inspections comes up with the expected sign and comparable coefficients we get a quite heterogeneous picture for the pick up possibilities, the number of valuations, the price level, and the relative shipping cost with some of the coefficients being even positive in some product categories - the not-binding referral requests might be responsible for these ambivalent results. As referral requests only serve as a pre-purchase screening of potentials sellers, customers might take some of the quality and reliability indicators less serious: searching for the best supplier means to check different categories of e-tailers and to compare them amongst each other. In the actual purchasing decision things might be different.

Impact on purchase clicks (last-click-throughs): If instead of referral requests our 'last-click-through' concept is applied our results improve substantially and get more consistent across product groups. For the categories ('Games' and 'Software') a series of service quality variables and firm-specific control variables are not relevant any more. These are simple and standardized products; so it might be that for such products service quality is less important. On the other hand, these are product groups with a relatively small market in Geizhals.at.

Compared to referral requests we observe that the factor *Payment* is gaining relative importance and has the expected sign in all categories; it is the most important contributing factor in all categories, being second only in the field of 'Games' and 'Audio/HIFI' products. The influence of the factor *Order* is

clearly higher for the LCT-concept which is much closer to actual purchases compared to referral request. Interestingly, a better *Web Presence* is significantly furthering sales in all categories, *Net Performance* is furthering demand in four categories.

The importance of all service characteristics for the categories 'Household' are generally high. For that category even the factor *Service* has a significant negative impact. *Service* could be important for those products where consumers expect the utilization of service features with a higher probability (refrigerators, washing machines, ...) than for other goods with a shorter product life-cycle. If significant most of the coefficients for the other firm specific controls have the correct sign. In the category 'Household articles' the big importance of the relative price, the German dummy and the pick-up possibility is remarkable. This again might be explained with a higher probability that consumers want to get in direct contact with the retailer. Reliability - measured as the number of evaluations a shop got - is most important in the categories 'Audio/HiFi' and 'Video/Photo/TV' which might be explained by the larger necessity of service for these products in general.

5 Managerial implications and conclusions

Vertical and horizontal service differentiation is an important argument to explain the high price dispersion for homogenous products in e-commerce. Based on factor analysis of customers' service valuations and regression analysis of click data from an Austrian price search engine (www.geizhals.at) we have empirical evidence for the following managerial conclusions:

- In their marketing mix online shops have to be aware that aspects of service quality influence the *attention* for a specific online shop in price search engines on the one hand and *actual online sales* on the other hand in different ways[15].

- The relative product price is the most important variable in e-business, however, customers' valuations for online-shops service quality have high impact both on attention and on sales.

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[15]We measure the attention to online shops by referral requests from a price search engine. Actual sales are approximated by the so-called 'last-click-through' concept.

- Pick up possibility at the shop and immediate availability of the product are important for clicks and in a much higher degree for sales. The contrary is true for the reputation of being a low cost shop - this reputation is particularly helpful to attract window-shoppers, but for real sales it has a much lower impact.

- Even if there are no language barriers and an integrated market without customs restraints is given we observe a disadvantage of foreign e-commerce shops. Online shops which are interested in cross border shopping have to invest into the establishment of trust and confidence to overcome this cross border disadvantage.

- Service quality with respect to payment conditions is the single most important quality indicator especially in the 'Hardware' category. Particularly satisfaction with the terms of payment (e. g. various payment possibilities like credit cards, cash on delivery, ...) and the terms of shipping cost (including the amount of shipping cost as well as the satisfaction with shipping options) have to be mentioned.

- *Net performance* (mainly the speed of the retailer's website) as well as the *Web Presence* in general (convenience of navigation, assortment, offered product information) are the most important service qualities for the product categories 'Audio/Hifi' , 'Household articles' , and 'Video/Photo/TV' . Especially the quality (clarity) of navigation and the product information matter.

- Factors related directly to the order-process (especially delivery time, confirmation of ordering, package tracking, validity of information) are important for sales of 'Hardware' and 'Household articles' .

- Price and service quality related variables have quantitatively much higher impacts for 'Household articles' compared to all other product categories. For this product category the before and after service quality plays a much larger role for the customer behavior - a result which could be related with the importance of the enforcement of guarantee claims for these products.

- As potential customers can never be sure about the reliability of the service quality information of the shops which is provided by fellow shop-

16

pers, they are much more relaxed if the number of such evaluations is high. This result gives an important role for the intermediary, the shopbot: increasing the reliability of the evaluations by encouraging customer feedback and by careful quality management to detect 'gaming' is highly rewarding.

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Table 1: Descriptives of 'Geizhals-Data'[a]

Variable	Mean	Std.Dev.	Min	Max	Description
#Clicks	0.62	6.54	0.00	3434.00	Number of clicks (referral requests) from consumers for firms' product offers
LCT prod-month	0.04	0.45	0.00	156.00	Identification of 'purchase click' with 'last-click-through' concept on product level with one month between search intervals
LCT subsubc-month	0.03	0.26	0.00	70.00	Identification of 'purchase click' with 'last-click-through' concept on subsubcategorial level with one month between search intervals
LCT prod-week	0.04	0.45	0.00	158.00	Identification of 'purchase click' with 'last-click-through' concept on product level with one week between search intervals
LCT subsubc-week	0.03	0.26	0.00	70.00	Identification of 'purchase click' with 'last-click-through' concept on subsubcategorial level with one week between search intervals
Firm evaluation	1.74	0.47	1.05	3.55	Customers' average evaluations of the e-tailer (1 best and 5 worst)
Navigation	1.76	0.44	1.00	3.40	Customers' evaluations of etailer's website navigation (1 best and 5 worst)
Assortment	1.86	0.55	1.00	3.80	Customers' evaluations of etailer's assortment (1 best and 5 worst)
Product Info	1.93	0.49	1.00	3.80	Customers' evaluations of etailer's product information (1 best and 5 worst)
Service before Buy	1.83	0.66	1.00	4.43	Customers' evaluations of etailer's service before buy (1 best and 5 worst)
Price level	1.58	0.36	1.00	3.33	Customers' evaluations of etailer's price level (1 best and 5 worst)
Shipping Cost	1.70	0.52	1.00	3.80	Customers' evaluations of etailer's shipping cost (1 best and 5 worst)
Terms of Payment	1.72	0.42	1.00	3.80	Customers' evaluations of etailer's terms of payment (1 best and 5 worst)
Terms of Business	1.81	0.55	1.00	4.40	Customers' evaluations of etailer's terms of business (1 best and 5 worst)
Website Performance	1.64	0.34	1.00	3.40	Customers' evaluations of etailer's website performance (1 best and 5 worst)
Order Transaction	1.56	0.45	1.00	3.47	Customers' evaluations of etailer's order transaction (1 best and 5 worst)
Validity of Info	1.85	0.66	1.00	4.40	Customers' evaluations of etailer's validity of information (1 best and 5 worst)
Confirmation/Package tracking	1.77	0.63	1.00	4.20	Customers' evaluations of etailer's confirmation/package tracking (1 best and 5 worst)
Delivery Time	1.77	0.64	1.00	4.20	Customers' evaluations of etailer's delivery time (1 best and 5 worst)
Packing	1.48	0.46	1.00	5.00	Customers' evaluations of etailer's packing (1 best and 5 worst)
Service after Buy	1.90	0.69	1.00	4.60	Customers' evaluations of etailer's service after buy (1 best and 5 worst)
Order	0.00	1.00	-2.34	4.45	Rotated principal factor 'Order'
Web Presence	0.00	1.00	-2.53	5.05	Rotated principal factor 'Web Presence'
Payment	0.00	1.00	-3.20	6.42	Rotated principal factor 'Payment'
Servic	0.00	1.00	-4.99	4.35	Rotated principal factor 'Service'
Net Performance	0.00	1.00	-2.78	5.95	Rotated principal factor 'Net Performance'
Rel. Price	1.00	0.18	0.01	7.96	Firm's product price relative to the market's mean product price
Rel. Shipping Cost	1.00	0.40	0.08	3.38	Firm's shipping cost (cash on delivery) relative to the average (imputation with mean if not available)
Miss. Ship. Cost	0.11	0.31	0.00	1.00	Dummy: 1 if shipping cost are not available
Germany	0.69	0.46	0.00	1.00	Dummy: 1 if firms' country of origin is Germany. 0 if country of origin is Austria
Avail	0.29	0.45	0.00	1.00	Dummy: 1 if offered product is immediately available
Pick up	0.24	0.43	0.00	1.00	Dummy: 1 if e-tailer offers pick-up possibility
Price level	1.00	0.07	0.24	1.47	General price level of the firm relative to the average general price level
#evaluations	0.11	0.16	0.01	1.08	Number of customers' evaluations per firm (in 1000)
#inspection	1.56	1.72	0.04	10.15	Number of customers' evaluation inspections per firm (in 1000)

[a] Descriptives refer to retailers' price offers and customers' referral clicks for an arbitrary week in the year 2008.
Source: Price search engine http://www.geizhals.at and own calculations.

Table 2: Correlation coefficients of customers' evaluations

	Navigation	Assortment	Product Info	Service before Buy	Price level	Shipping Cost	Terms of Payment	Terms of Business	Website Performance	Order Transaction	Validity of Info	Confirmation/Package Tracking	Delivery Time	Packing	Service after Buy
Navigation	1														
Assortment	0.7818	1													
Product Info	0.9078	0.8068	1												
Service before Buy	0.6916	0.8183	0.7282	1											
Price level	0.5685	0.5807	0.5710	0.5347	1										
Shipping Cost	0.7440	0.7844	0.7494	0.7902	0.5934	1									
Terms of Payment	0.6546	0.7229	0.7019	0.7507	0.4802	0.8436	1								
Terms of Business	0.7179	0.7864	0.7823	0.8247	0.6154	0.7994	0.8312	1							
Website Performance	0.8011	0.7854	0.7927	0.7265	0.5351	0.7111	0.6754	0.7826	1						
Order Transaction	0.7514	0.8860	0.7765	0.8542	0.5770	0.8369	0.7708	0.8272	0.8059	1					
Validity of Info	0.7313	0.9367	0.7682	0.8059	0.6132	0.7736	0.6916	0.7886	0.7732	0.8967	1				
Confirmation/Package Tracking	0.6549	0.8036	0.7008	0.7774	0.4919	0.7905	0.7289	0.7582	0.6970	0.8966	0.8486	1			
Delivery Time	0.6803	0.9085	0.7206	0.8304	0.4998	0.8025	0.7379	0.7745	0.7321	0.9105	0.9199	0.9100	1		
Packing	0.6696	0.8055	0.7120	0.8337	0.5192	0.7874	0.7511	0.8335	0.7212	0.8635	0.8421	0.8541	0.8743	1	
Service after Buy	0.6606	0.8349	0.7351	0.8804	0.5122	0.7733	0.7475	0.8474	0.7401	0.8791	0.8727	0.8795	0.8996	0.8927	1

[a] Figures depict correlation coefficients of customers' evaluations of different service characteristics by retailers. Source: price search engine *http://www.geizhals.at* and own calculations.

Table 3: Rotated factor loadings[a]

	Order	Web Presence	Payment	Service	Net Performance	Uniqueness
Navigation	0.3112	**0.8448**	0.2769	0.1526	0.2096	0.0456
Assortment	**0.6977**	**0.5271**	0.2505	0.2163	0.1988	0.0864
Product Info	0.347	**0.7919**	0.2924	0.2657	0.1873	0.0613
Service before Buy	**0.5445**	0.3682	0.3475	**0.5894**	0.122	0.0848
Shipping Cost	**0.4945**	0.4298	**0.677**	0.1597	0.1026	0.0764
Terms of Payment	0.3469	0.2997	**0.7875**	0.2681	0.202	0.057
Terms of Business	0.3898	0.3691	**0.4936**	**0.5184**	0.3574	0.0716
Website Performance	0.3928	**0.5201**	0.2549	0.1995	**0.6704**	0.021
Order Transaction	**0.7048**	0.3871	0.3803	0.2414	0.2805	0.0719
Validity of Info	**0.7716**	0.4284	0.2184	0.2298	0.2318	0.0668
Confirm./Package track.	**0.787**	0.2531	0.3953	0.1793	0.1853	0.0939
Delivery Time	**0.8221**	0.3123	0.3228	0.2284	0.1714	0.0408
Packing	**0.6557**	0.2659	0.3741	0.4475	0.2142	0.1133
Service after Buy	**0.6887**	0.2761	0.3149	**0.4955**	0.2147	0.0587

[a]Method: Figures depict rotated factor loadings of service characteristics in a principal component analysis with orthogonal varimax rotation. Factor loadings above 0.49 are printed in bold. Uniqueness is the proportion of variance of the variable (e.g. Navigation) that is not accounted for by all of the factors taken.

Table 4: Impact of service characteristics on demand

Variable	ALL CLICKS	ALL CLICKS	LCT PRODUCT MONTH	LCT PRODUCT WEEK	LCT SUBSUBCAT MONTH	LCT SUBSUBCAT WEEK
Firm Evaluation	-0.055***					
	(-0.002)					
Order		-0.010***	-0.021***	-0.021***	-0.020***	-0.020***
		(-0.001)	(-0.002)	(-0.002)	(-0.003)	(-0.003)
Web Presence		-0.018***	-0.025***	-0.025***	-0.022***	-0.022***
		(-0.001)	(-0.002)	(-0.002)	(-0.003)	(-0.003)
Payment		-0.026***	-0.040***	-0.040***	-0.041***	-0.041***
		(-0.001)	(-0.002)	(-0.002)	(-0.003)	(-0.003)
Service		0.010***	0.011***	0.011***	0.009***	0.007***
		(-0.001)	(-0.002)	(-0.002)	(-0.002)	(-0.002)
Net Performance		-0.020***	-0.022***	-0.022***	-0.022***	-0.022***
		(-0.001)	(-0.002)	(-0.002)	(-0.003)	(-0.003)
Rel. Price	-1.354***	-1.356***	-1.550***	-1.553***	-1.663***	-1.732***
	(-0.01)	(-0.007)	(-0.04)	(-0.04)	(-0.062)	(-0.066)
Rel. Shipping Cost	0.011***	0.016***	0.016***	0.016***	0.024***	0.022***
	(-0.001)	(-0.001)	(-0.004)	(-0.004)	(-0.005)	(-0.005)
Germany	-0.217***	-0.218***	-0.273***	-0.275***	-0.272***	-0.288***
	(-0.002)	(-0.002)	(-0.008)	(-0.009)	(-0.012)	(-0.012)
Avail	0.105***	0.108***	0.163***	0.163***	0.167***	0.170***
	(-0.002)	(-0.002)	(-0.006)	(-0.006)	(-0.008)	(-0.008)
Pick up	0.039***	0.037***	0.067***	0.067***	0.064***	0.069***
	(-0.002)	(-0.002)	(-0.005)	(-0.005)	(-0.006)	(-0.006)
Price level	-0.360***	-0.394***	-0.311***	-0.313***	-0.212***	-0.233***
	(-0.013)	(-0.012)	(-0.035)	(-0.035)	(-0.042)	(-0.043)
#Evaluations	0.047***	0.060***	0.053***	0.051***	0.021	0.025
	(-0.005)	(-0.006)	(-0.015)	(-0.015)	(-0.018)	(-0.018)
#Inspections	0.033***	0.032***	0.037***	0.038***	0.042***	0.043***
	(-0.001)	(-0.001)	(-0.002)	(-0.002)	(-0.002)	(-0.002)
Observations	873527	873527	406262	405962	311258	310322
Products	37348	37348	11584	11572	8907	8869
Mean(Clicks/Product)	13.76	13.76	3.28	3.29	2.397	2.403
χ^2	94062	95121	15951	15967	11468	11427
LL	-433458	-432337	-75449	-75430	-46257	-46155

Dependent variable: all clicks (referral requests) in the first two columns and 'last-click-throughs' (LCT) in the last four columns. Estimation method: negative binomial regression model with fixed effects for the products. Coefficients represent marginal effects. Standard errors in parentheses. *, ** and *** indicate statistical significance at the 10-percent level, 5-percent level, and 1-percent level, respectively. Missing flag for missing shipping cost is not reported.

Table 5: Impact of service characteristics on referral requests of various product categories

Category	Audio/HIFI	Games	Hardware	Household	Software	Video/Photo/TV
	Panel A: Aggregated Firm Evaluations					
Firm Evaluation	-0.045***	-0.038*	-0.052***	-0.283***	-0.084***	-0.035***
	(0.006)	(0.02)	(0.002)	(0.017)	(0.01)	(0.003)
Rel. Price	-1.414***	-2.035***	-1.153***	-3.036***	-1.251***	-1.698***
	(0.037)	(0.118)	(0.011)	(0.089)	(0.072)	(0.026)
Other Controls	yes	yes	yes	yes	yes	yes
	Panel B: Disaggregated Firm Evaluations					
Order	0.016***	0.067***	-0.015***	-0.064***	-0.023***	0.005***
	(0.003)	(0.011)	(0.001)	(0.007)	(0.004)	(0.002)
Web Presence	-0.041***	-0.079***	-0.011***	-0.094***	-0.026***	-0.027***
	(0.004)	(0.015)	(0.001)	(0.008)	(0.004)	(0.002)
Payment	-0.037***	-0.041***	-0.025***	-0.038***	-0.021***	-0.029***
	(0.003)	(0.009)	(0.001)	(0.006)	(0.004)	(0.002)
Service	0.006**	-0.006	0.014***	-0.048***	-0.001	0.011***
	(0.003)	(0.009)	(0.001)	(0.007)	(0.005)	(0.001)
Net Performance	-0.031***	0.01	-0.021***	-0.070***	-0.012***	-0.010***
	(0.003)	(0.009)	(0.001)	(0.006)	(0.004)	(0.001)
Rel. Price	-1.409***	-2.029***	-1.156***	-3.030***	-1.263***	-1.676***
	(0.038)	(0.119)	(0.011)	(0.09)	(0.073)	(0.026)
Rel. Shipping Cost	0.045***	-0.011	0.005***	-0.023*	0.034***	0.048***
	(0.006)	(0.024)	(0.002)	(0.013)	(0.009)	(0.003)
Germany	-0.243***	-0.267***	-0.190***	-0.351***	-0.145***	-0.277***
	(0.01)	(0.029)	(0.003)	(0.019)	(0.013)	(0.006)
Avail	0.113***	0.130***	0.096***	0.076***	0.091***	0.124***
	(0.007)	(0.025)	(0.002)	(0.012)	(0.01)	(0.004)
Pick up	0.009	-0.035	0.047***	0.053***	-0.023***	-0.010***
	(0.007)	(0.026)	(0.002)	(0.014)	(0.008)	(0.003)
Price level	-0.198***	0.931***	-0.502***	-0.171	-0.682***	-0.044
	(0.055)	(0.199)	(0.014)	(0.123)	(0.088)	(0.029)
#Evaluations	0.133***	0.179	0.017***	-0.257***	-0.044	0.221***
	(0.027)	(0.11)	(0.006)	(0.075)	(0.034)	(0.013)
#Inspections	0.031***	0.035***	0.033***	0.097***	0.033***	0.011***
	(0.003)	(0.009)	(0.001)	(0.007)	(0.003)	(0.001)
Observations	56163	16444	558550	51233	33072	143839
Products	3744	1478	16893	5994	1245	5858
Mean(Clicks/Product)	10.28	6.05	18.31	6.72	5.77	17.64
χ^2	7609	2158	59172	5951	2266	21705
LL	-34945	-7852	-254047	-31521	-9991	-84300

Dependent variable: all clicks (=referral requests). Estimation method: negative binomial regression model with fixed effects for the products. Coefficients represent marginal effects. Standard errors in parentheses. *, ** and *** indicate statistical significance at the 10-percent level, 5-percent level, and 1-percent level, respectively. Missing flag for missing shipping cost is not reported.

Table 6: Impact of service characteristics on 'last-click-throughs' of various product categories

Category	Audio/HIFI	Games	Hardware	Household	Software	Video/Photo/TV
Panel A: Aggregated Firm Evaluations						
Firm Evaluation	-0.073***	-0.154*	-0.088***	-0.404***	-0.041	-0.064***
	(0.02)	(0.087)	(0.006)	(0.087)	(0.025)	(0.009)
Rel. Price	-1.488***	-2.813***	-1.387	-3.981***	-1.066***	-2.055***
	0.162)	(0.703)	(0.046)	(0.572)	(0.296)	(0.107)
Other Controls	yes	yes	yes	yes	yes	yes
Panel B: Disaggregated Firm Evaluations						
Order	0.022**	0.042	-0.030***	-0.087***	-0.013	-0.007*
	(0.009)	(0.04)	(0.003)	(0.032)	(0.012)	(0.004)
Web Presence	-0.063***	-0.149**	-0.016***	-0.087**	-0.018*	-0.034***
	(0.013)	(0.06)	(0.002)	(0.039)	(0.011)	(0.005)
Payment	-0.044***	-0.052	-0.037***	-0.138***	-0.028**	-0.043***
	(0.01)	(0.033)	(0.003)	(0.035)	(0.013)	(0.004)
Service	-0.004	-0.025	0.016***	-0.088***	0.022*	0.015***
	(0.009)	(0.035)	(0.002)	(0.032)	(0.013)	(0.004)
Net Performance	-0.039***	0.036	-0.024***	-0.091***	0.015	-0.017***
	(0.01)	(0.03)	(0.003)	(0.031)	(0.011)	(0.004)
Rel. Price	-1.485***	-2.787***	-1.386***	-4.038***	-1.103***	-2.005***
	(0.165)	(0.692)	(0.046)	(0.582)	(0.314)	(0.106)
Rel. Shipping Cost	0.059***	-0.118	-0.004	-0.057	0.005	0.059***
	(0.019)	(0.089)	(0.005)	(0.064)	(0.021)	(0.007)
Germany	-0.317***	-0.441***	-0.212***	-0.890***	-0.245***	-0.380***
	(0.039)	(0.148)	(0.009)	(0.151)	(0.074)	(0.022)
Avail	0.208***	0.122	0.146***	0.253***	0.107***	0.171***
	(0.03)	(0.083)	(0.007)	(0.065)	(0.037)	(0.012)
Pick up	0.03	0.069	0.076***	0.154**	0.014	0.009
	(0.022)	(0.093)	(0.006)	(0.071)	(0.021)	(0.009)
Price level	0.318*	0.677	-0.480***	0.006	-0.471*	0.132*
	(0.167)	(0.702)	(0.042)	(0.563)	(0.243)	(0.072)
#Evaluations	0.148*	0.148	0.01	-0.281	0.11	0.272***
	(0.084)	(0.357)	(0.017)	(0.367)	(0.075)	(0.033)
#Inspections	0.031***	0.021	0.041***	0.101***	0.017**	0.008**
	(0.009)	(0.03)	(0.002)	(0.035)	(0.008)	(0.003)
Observations	27255	4337	268567	15322	9844	78439
Products	1148	247	6267	1307	244	2222
Mean(Clicks/Product)	2.36	2.56	3.67	2.00	1.95	3.78
χ^2	1035	225.1	9806	665.8	378.2	4866
LL	-5711	-1018	-45513	-4228	-1205	-16651

Dependent variable: last-click-through on the product level for which a break of one month initiates a new search interval. Estimation method: Negative Binomial Regression Model with fixed effects for the products. Coefficients represent marginal effects. Standard errors in parentheses. *, ** and *** indicate statistical significance at the 10-percent level, 5-percent level, and 1-percent level, respectively. Missing flag for missing shipping cost is not reported.