

Umbrella branding effects: Empirical evidence from product tests ^{*}

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Abstract

We study empirically price decisions of multi-product firms that sell their products in experience goods markets under a common brand name. We test whether firm reputation can be leveraged across the products of the umbrella brand by exploiting an exogenous information shock generated by the publication of product test results. For estimation we combine quality data from 2,736 product tests with daily price observations for the period 2016-2018. The results show that a very good test result has a positive and significant effect on the prices of other umbrella products, whereas a negative test result is associated with a price reduction. We find umbrella effects to be stronger for reputable firms.

JEL Classifications: L15, D18, D22

Key Words: Asymmetric Information, Quality Disclosure, Umbrella Branding, Reputation.

1 Introduction

Individual firm reputation is a valuable intangible asset for firms (Kreps (1990), Tadelis (1999)). The brand name is linked to information about firms' past behaviour and is a carrier of a firm's reputation. Consumers rely on the brand name and image to infer product quality in markets characterized by asymmetric information. Consequently reputational concerns provide firms

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with incentives to provide high quality and reputation is an important mechanism to overcome moral hazard problems and sustain quality in markets for experience goods (Shapiro (1983), Klein and Leffler (1981), Tadelis (2002)).

In a multi-product environment firms can extend a brand name of an established product to other different related or unrelated product categories. This brand extension or umbrella branding strategy can be a means to signal quality to consumers (Wernerfelt (1988), Cabral (2000)) and can serve a substitute for other quality signaling instruments such as product certification (Hakenes and Peitz, 2009) or price signaling (Choi, 1998). Choi (1998) shows that umbrella branding allows firms to solve asymmetric information problems in the market for new products with less price distortions. Andersson (2002) discusses benefits of firms from economies of scale in pooling reputations. Nevertheless, umbrella branding may be also a risky strategy due to reputational spillover effects of the products sold under the same umbrella brand (Tadelis (1999), Rasmusen (2016)). Cabral (2000) argues that the punishment of past bad performance might be much more severe under umbrella branding, since it may affect all products of the umbrella brand.

This study provides empirical evidence on reputational spillover effects across umbrella branded products, by exploiting the exogenous increase in information about product quality through the publication of product test results. We estimate the immediate price responses of umbrella branded products after the disclosure of quality information. An empirical challenge in identifying umbrella branding effects is to isolate the causal effect of reputation of a brand name across product markets. We exploit the new information about the performance of the items tested as a exogenous shock to the brand reputation to identify the cross-reputation effects. This exogenous change in information about quality and the quasi-randomness of the event and of the set of products tested on a certain date allows us to estimate the reputation spillover effects on prices based on a RDD-type approach. *If umbrella branding provides information, the disclosure of quality should have an effect not only on prices of the products whose quality is being disclosed (Rroshi and Weichselbaumer, 2021), but also on prices of other (untested products) that are sold under the umbrella brand.*¹ *Experimental evidence (Aaker and Keller (1990)) has shown that consumers form their expectations about quality of umbrella products by relying on previous experience with the parent product. In actual markets, it is difficult to measure the extent of information that consumers possess.*

¹For umbrella branding to be a successful quality signal, consumers should be aware that the products are from the same firm. Umbrella effects can also arise due to exchange of information between consumers, where each consumes one of the products of the umbrella brand and communicates the experience to the other (Belleflamme and Peitz, 2015).

We use data on product quality that are published monthly by Stiftung Warentest, a consumer protection agency in Germany. Every month, the agency tests a range of product categories that are characterized by asymmetric information problems. The analysis combines the quality data from the product tests with daily price observations from a price comparison website (Geizhals). The dataset includes 2,736 products tested over the period 2016-2018. An advantage of daily data is that we can look at the immediate effect on prices. The time frame of our analysis (105 days around the event time) allows us to exclude the effect on prices coming from other sources of information, such as information from additional accumulated experience by consumers. Moreover, because consumers already have some expectations regarding quality based on their past experience with a particular brand or may be loyal to a particular brand even after observing a bad quality in a single instance, it is important that we control for reputation (past quality) in the extended analysis of the umbrella effects.

We contribute to the literature in three main aspects. First, we provide evidence regarding the informational role of umbrella branding. Because revealing the quality of a product affects the beliefs of the consumers regarding the quality of the other umbrella products, we can interpret changes in prices of other products as evidence of umbrella brands successfully fulfilling their signaling role. Second, the information contained in the data and the clear identification strategy allows us to investigate the interrelationship between product quality, reputation and umbrella branding in a wide range of experience goods markets. In the empirical analysis we test for umbrella effects by conditioning on firm reputation to test if there is any difference in umbrella effects between reputable and non-reputable firms. In addition, the quality data combined with daily price data allows us to test if the reputation of a brand is leveraged across the other umbrella products. We test whether a good test results for a particular product of the brand, which means an increase in the reputation of the firm, generates a reputational premium for other products in the umbrella brand. Third, we also contribute to the literature on the effects of information provision on the market outcomes for experience goods. Our results suggest that apart from direct effects, there are also indirect informational spillover effects of quality disclosure generated by umbrella branding.

The empirical analysis shows the following results: First, reduced form results show that there is a positive relationship between the size of the umbrella and mean quality of the products of the brand. This confirms the hypothesis in Cabral (2009) and Hakenes and Peitz (2008), that umbrella branding provides incentives to maintain quality since the punishment in an umbrella may affect many products at once. Second, regarding the price dynamics we find that very good test results of a brand bring about a price premium for other umbrella products,

whereas bad test results lead to a decrease in prices. When conditioning on reputation we see that reputable firm do increase prices, even when the test result is bad. One interpretation for that reaction is that reputable firms in the case of a bad test result instead of lowering prices to match the expectations of the informed consumers about the brand, exploit their reputation by increasing prices — as if they were signaling high quality via price — to mislead the remaining uninformed consumers in the market. The significant umbrella effects have important policy implications. Umbrella branding brings about important informational externalities for good products, because they amplify the information provided by the test results, suggesting a crucial role of product testing for the efficient functioning of these markets. For very good products, though, consumers which remain unaware of reputation information even after the quality test, could be worse off because they may pay higher prices for low quality.

In the next Section we review the related theoretical and empirical literature on umbrella branding. Section three discusses the estimation approach; the fourth Section presents the data. In Section five we present the results. The last Section concludes.

2 Related Literature

An important question in the asymmetric information literature is the study of mechanisms to overcome the adverse selection and moral hazard problems and sustain quality in experience goods markets. One market mechanism is firm reputation (Klein and Leffler (1981), Shapiro (1983), Tadelis (2002)). In the theoretical models reputation of a firm is defined as the quality of products delivered by the firm in the past. In the models of Klein and Leffler (1981) and Shapiro (1983) the repeat purchase mechanism solves the moral hazard problem and high quality is sustained in every period provided that high quality is associated with a price premium.

Closely related to quality provision incentives in repeat purchase situations and the importance of reputation is the strategy of naming multiple products with the same brand name. Umbrella branding is considered as an important business practice in experience goods markets that provides information (Wernerfelt, 1988) and reduces consumers' quality uncertainty (Montgomery and Wernerfelt, 1992). A main insight of the theoretical literature is that apart from its signaling role, umbrella branding also affects the incentives of firms to provide quality (Andersson (2002), Cabral (2009)). In all models of firm reputation and umbrella branding, consumer beliefs play an important role in generating these reputation incentives in a dynamic environment. The theoretical models show that if the beliefs of the consumers regarding the quality of products are correlated within products of the umbrella brand, then firms will have

higher incentives to provide higher quality under the umbrella compared to single branding. However, similarly to the reputation in models single brands, umbrella branding may serve as a quality assuring mechanism but does not necessarily guarantee quality (Hakenes and Peitz, 2009). An important and interesting open empirical question is whether product quality is correlated under the umbrella. We test this hypothesis in the cross-section analysis of our data for a wide range of product categories.

Umbrella branding may also allow firms to leverage the reputation of an established product to other products in the same or in an unrelated product category (Pepall and Richards (2002), Miklós-Thal (2012) and Rasmusen (2016)). The empirical literature has investigated spillover effects in the context of marketing mix strategies and their effect on consumer choice in umbrella branding (Sullivan (1990), Erdem and Sun (2002), Balachander and Ghose (2003), Suppliet (2020)). Other studies investigate the factors that affect the success of brand extension and emphasize that consumers' quality perceptions of the parent brand will be transferred to the new product introduced under the umbrella if the two product categories are perceived to fit (Aaker and Keller (1990), Hem et al. (2003), Völckner and Sattler (2006), Loken and John (1993), Miklós-Thal (2012)). In sum, these studies provide evidence for the informational role of umbrella branding and emphasize that consumers beliefs are an important mechanism for understanding how and why umbrella branding works (namely through the transfer of perceptions or experience with the parent brand to the other products in the umbrella) but do not consider reputation spillovers.

There is only scarce empirical work in the economics literature looking at how umbrella branding affects firms' pricing decisions. Two related studies use product recall data to investigate the effect on firm value and consumer choice, but have no information about product prices and their change after the product recalls. Jovanovic (2020) finds that product recalls in the transportation equipment sector lead to a reduction in stock-prices and the value of the firm but does not have data on prices of the products sold by the firm. Similarly, Freedman et al. (2012) estimate the effect of product recalls on sales for children toys but find no spillover effects on the sales of other types of toys that were not involved in the recall. Apart from evidence from the wine market by Pennerstorfer et al. (2019), which find that investments in product quality of the top product generate a reputational dividend for other products with lower quality, the question of the leveraging of reputation through umbrella branding has not been investigated empirically so far ².

²There is evidence on reputational spillover effects emerging from collective brands in an international trade context. Bai et al. (2021) provide empirical evidence on the role of collective reputation in international trade

To estimate these cross-reputation effects some kind of exogenous variation in reputation is needed. We use the disclosure of quality information through product test results as an exogenous shock to brand reputation in combination with daily price data to estimate the effect of information on prices of umbrella products. The theoretical literature discussed above implies that the effect of quality information on prices of the other products under the umbrella, which were not (yet) tested, is ambiguous. On the one hand, the availability of information through product tests weakens the value of reputation to signal quality, and therefore should reduce the price premium associated with this reputation. Moreover, it reduces the asymmetric information which leads to a reduction of price distortions and therefore lower prices. On the other hand, test results also have a direct effect on the reputation of the brand, because the quality at the time of release influences the reputation in the following period(s). The literature also suggests that reputable firms have higher incentives to offer products in an umbrella brand, and conditional on umbrella branding they offer high quality to avoid damaging their good reputation. In a theoretical model by Faulhaber and Yao (1989) investigate the effect of product reviews on prices charged by firms with an established reputation and find that the reputable firms will increase their prices following product reviews. We will take into account this aspect in the empirical analysis, where we separate the estimation for reputable and non-reputable firms.

3 Empirical setting

We use test results from a consumer protection agency to estimate the spillover effects of information on umbrella branded products. To this aim we estimate the price reaction after a quality test has been published for the other goods sold under the same brand. Concretely, we look at how prices $p_{j_k,t}$, with $j_k \in \{-i_k\}$, react when “base-product” i_k of brand k is tested in $t_0 = t - 1$, with $M_k = \{-i_k, i_k\}$ being the set of products sold under the umbrella brand k .

To understand the effect that the product test information can have within the umbrella brand, we differentiate the products in $\{j_k\}$ by the information available about them at t_0 . The first group of products consists of those where no prior quality information is available from a

using as a natural experiment the scandal in the Chinese dairy industry in 2008. Difference in difference results show that after the scandal there was an immediate drop in export revenues not only for firms involved in scandal but exports fell by about 57% for firms that had no contaminated products suggesting negative (and persistent) reputational spillover effects for other Chinese firms. A similar study by Bachmann et al. (2017) investigates the damages in the reputation of the collective brand “made in Germany” following the Volkswagen emissions scandal in 2015. The finding suggests that the scandal reduced the sales growth rates of the non-VW German automakers by 9.2 percentage points relative to their non-German counterparts.

quality test result. The second group considers products j_k that are tested before t_0 , which means product quality test information is already available from some earlier test. We expect that the price effect is larger for products where no prior test results are available, because then the brand conveys more additional information about the product quality. Our empirical approach will therefore, separate two groups of brand products j_k : (1) products yet tested; (2) products j_k tested after the testing of i_k ³.

To estimate the umbrella effect we employ an RDD-like approach around the event of quality disclosure. We use a dummy with parameter γ to estimate the event effect for each ordinal quality grade result of the base product. The event is defined by the point of time the test results are published. The basic specification which we estimate for each grade for durables and non-durables is given by:

$$\frac{P_{j_k,t}}{P_{j_k,-105}} = \gamma \cdot 1[t > 0] + \sum_{a=0}^{a=4} \alpha_a t^k + \delta \cdot 1[0 \leq t \leq 4] + D_{j_k} \mu + \epsilon_{j_k,t} \quad (1)$$

with the dependent variable given by the price of product $j_k \in \{-i_k\}$ sold under the umbrella brand when product i_k of the umbrella brand k is tested. t is measured in relative time, going from -105 to 105 days after the event for each product i_k . α_a fits a fourth-order polynomial. δ makes it possible to allow for a time lag of four days for the impact of the revealed quality information on prices, because it takes some time until the information diffuses.

4 Data

We use data for products tested by a consumer protection agency in Germany (Stiftung Warentest). The data contains information about 2,736 products, both durables and non-durables tested in the years 2016-2018. The data were augmented by a match to daily prices listed on a price comparison website (geizhals.de). The sample is particularly well-suited for the analysis, because it is the aim of the consumer protection to test products from markets characterized by asymmetric information, for which quality cannot be evaluated before purchase (experience goods).

Table 1 shows the number of umbrella brands separated by umbrella size (number of products sold under the same brand name). There are 733 brands contained in the sample. On average,

³We avoid window-overlap with the base-product. That means, when the product for which we analyse its umbrella effect was tested on date t_0 , then only brand co-products are included when estimating the umbrella effect that are tested after $t_0 + 105$ days. This avoids having the own-product test-effect (see Rroshi and Weichselbaumer (2021)) appear in the RD-window of umbrella effects.

Table 1: Umbrella size and mean quality

	Number of products in umbrella brand bracket								All
	1	2-5	6-10	11-20	21-30	31-40	41-60	61-91	
Brands	360	283	45	26	6	5	4	4	733
Products	360	802	333	370	158	181	196	336	2,736
Durables	299	686	320	327	158	181	196	336	2,503
Non-durables	61	116	13	43	0	0	0	0	233
Quality	3.01	2.82	2.69	2.52	2.54	2.41	2.39	2.49	2.68
	(1.09)	(1.02)	(0.86)	(0.82)	(0.72)	(0.58)	(0.69)	(0.61)	(0.90)
Price	193.7	276.0	261.8	368.6	610.5	583.4	527.9	629.8	377.1
	(396.8)	(473.1)	(293.1)	(405.6)	(532.0)	(389.7)	(489.0)	(641.3)	(486.8)

Notes: Product-frequency brackets of brands. Mean quality and price per bracket, and number of products per bracket. Prices in January-2016 euro. Standard deviations in parentheses below variable means.

each brand has 3.7 products in the sample of tested products. The range is large, from 1 to 91 products. An umbrella size of 1 implies that 360 products are sold separately and not under an umbrella brand. About 87 percent ($1-360/2,736$) of the products in the sample are sold under an umbrella brand name. Two indented lines below the number of products per brand bracket show the division into durables and non-durables. There are many more observations for durable goods compared to non-durables, which hints to bigger asymmetric information problems in markets of durables. Non-durables are products that are purchased more frequently, which allows consumers to learn quality at a larger extent by experience.⁴

The last four lines of Table 1 show the average (standard deviation) of quality and price for each size category. Calculation of average quality and price is at the product level; e.g. for umbrella brands containing 2-5 products, there are 802 products overall, with an average quality of 2.82. For the most frequent umbrella brands, we list the frequency by name in Table 10, when there are at least 5 products of the brand in the raw data sample.

The sample size does not allow a separate analysis for non-durable products. Our estimation results rely therefore on durable products. Table 2 shows the summary statistics for each sub-sample. For the estimations, all products are included that are umbrella brand products of a brand that was tested at some point in time. The test date (t_0) of this base product defines the absolute window date of the umbrella products. We differentiate the results by the amount of quality information already available about the other umbrella products and divide

⁴There are still certain characteristics of the type of non-durable products tested that cannot be evaluated by experience, for instance the length of time a sunscreen appliance remains reliable, or potentially harmful substances in a handcreme or in baby food.

Table 2: Descriptive statistics of estimation samples

	(1)	(2)	(3)	(4)	(5)	(6)
	All		Better median quality		Worse median quality	
	Not tested before	Already tested	Not tested before	Already tested	Not tested before	Already tested
Price	419.96 (483.94)	405.21 (425.72)	518.86 (523.21)	442.57 (444.93)	252.42 (350.07)	303.95 (349.09)
P/\bar{P}	0.96 (0.12)	1.00 (0.17)	0.96 (0.11)	1.00 (0.17)	0.97 (0.13)	1.01 (0.17)
Grade	2.49 (0.81)	2.41 (0.68)	2.28 (0.65)	2.31 (0.58)	2.85 (0.93)	2.66 (0.84)
N	862,357	3,429,594	542,270	2,505,203	320,087	924,391

Notes: Means (standard deviations) of the untransformed Price and P/\bar{P} , which is the dependent variable where prices are measured relative to the product’s price at the beginning of the window, $t = -105$. Grade is the mean grade of all umbrella products in each sample. Prices in January-2016 euro.

the umbrella products in those that are not tested before, seen from t_0 ; and in those that were already tested before t_0 . To account also for differences in reputation between brands we split the sample in brands that have mean quality for all products above and below the median of the full sample of brands (see Columns (3) to (4) and (5) to (6) of Table 2).

5 Results

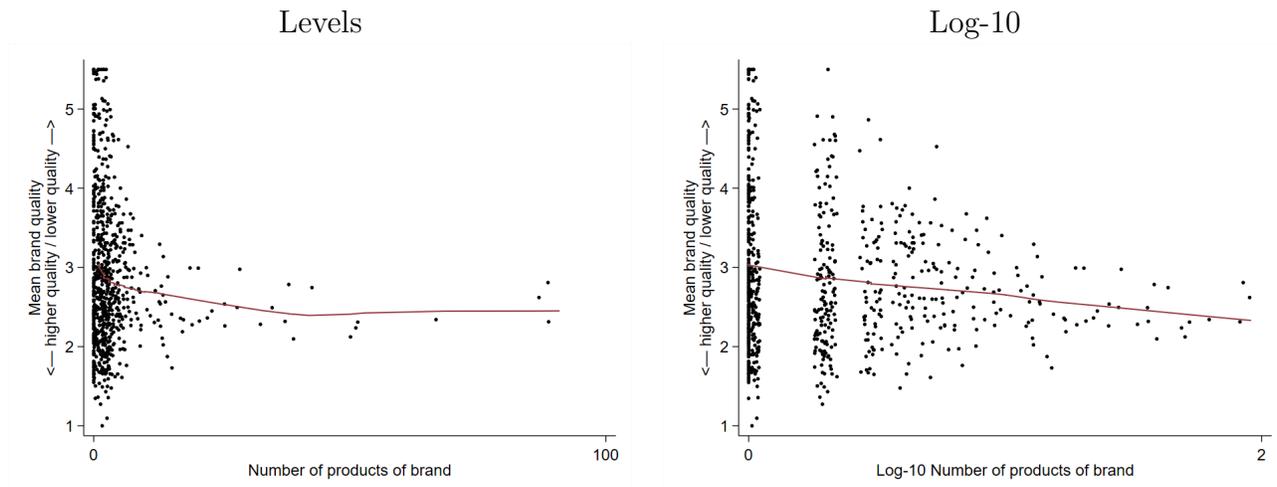
5.1 Umbrella brands’ quality

Umbrella branding can overcome moral hazard problems by conveying information about product quality to consumers. One of the main results of the theoretical literature is that firms’ incentives to provide higher quality are higher under the umbrella brand. Here we provide some first evidence — primarily descriptive, from the cross section of quality and umbrella branding — for the hypothesis that the quality of umbrella brand products is higher compared to products sold as a separate brand.

Table 1 shows that quality increases with umbrella size. This is first descriptive evidence that umbrella branding could help to sustain quality. The reason is that, the larger the umbrella size, the larger will be the loss in reputation of a firm in case it provides low-quality — compared to a smaller umbrella brand — therefore the greater the incentives to maintain high-quality.

Next, the relationship between quality (mean quality under the umbrella) and umbrella size is shown graphically in Figure 1. Because the number of products stretches far out on

Figure 1: Quality vs. umbrella size



Notes: Jitter added to avoid superimposition of duplicate values. Red line shows the locally weighted scatterplot smoother with bandwidth 0.8.

the left panel (“Levels”), the right panel shows the same after a log-10 transformation. Both show a locally weighted scatterplot smoother that makes it possible to discern a negative relationship. Note that a low grade in a test results indicates good quality and therefore the negative relationship here means a positive relationship between umbrella size and quality. To quantify the effect, in Table 3 we show the results from estimating a OLS regression, where we regress product quality on log-10 umbrella size and control for product price (relative to the test mean) and test fixed-effects. The estimate in Column (1) confirms a strong positive relationship between umbrella branding and product quality; the price relative to the other products in the test also has a highly significant negative effect, meaning that more expensive products have a higher quality. Column (2) and (3) split the sample for durables and non-durables. Durables (Column (2)) retain the highly negative relationship of umbrella size on quality. For non-durables (Column (3)) the umbrella size effect becomes insignificant and drops strongly in size. The price effect becomes positive (the reason and detailed analysis of this pattern is studied in Rroshi and Weichselbaumer (2021)).

For the price response analysis in the next Subsection, we focus on durable goods. One reason is that the results in Table 3 once more emphasize that durables and non-durables merit differentiated attention. Second, because few non-durables have other umbrella brands and price histories are available to a lower extent, there are not enough observations to obtain reliable results.

Table 3: Cross section relation of quality and umbrella size

	(1)	(2)	(3)
	All	Durables	Non-durables
$\log_{10}(\text{Umbrella size})$	-0.299*** (0.0324)	-0.269*** (0.0325)	-0.0589 (0.147)
$P_{i,\tau}/\bar{P}_\tau$	-0.228*** (0.0292)	-0.428*** (0.0339)	0.258*** (0.0649)
Constant	3.186*** (0.0447)	3.389*** (0.0471)	2.231*** (0.129)
Observations	2,736	2,503	233

Notes: Test-fixed effects included. Prices are relative to mean price of test. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5.2 Umbrella effects

The basis for the price effect on umbrella products is estimation of Equation (1), distinguished by quality of the base product. We test if at the time of the publication the test results of a tested product has an effect on prices of the other products in the umbrella. We investigate the effects separately for two groups: (i) umbrella products that were not tested before and (ii) umbrella products that were tested already. To avoid own-product test effects being mixed with the umbrella effects, products under the umbrella that were tested within 105 days of the base product were excluded. Our expectation is that for products that were not tested before the umbrella brand can be much more informative about product quality, meaning larger umbrella effects for this group.

The estimation results for products (not) tested before are depicted in Table 4 and Table 5 and the right (left) panel of Figure 2. Each column in the tables show the estimated effect on prices of the respective test grade. The results show that a very good test results has a positive and significant effect on the prices of other umbrella products. There is no effect of the test on the umbrella products prices for the other test grades for products not tested before. For products already tested, we see a similar positive umbrella effect of grade 1 products and no significant effects for products of grade 2 to 4, whereas for products of grade 5 the revelation of bad quality has a negative and significant effect on umbrella prices. If we compare the estimated size of the price changes with the results for products already tested, we see that the effects are larger for products not tested before. This confirms our expectation, because umbrella branding is more informative for these group of products, compared to products tested before, for which a larger share of consumers are informed.

In the results above we only look at the effect of quality on prices of umbrella products at

the time of the publication of the test results. This neglects the fact that reputation is built over time, and that many firms may have become reputable by consistently providing a high quality, while others have the image of low quality brands. These two groups of firms may employ umbrella branding strategy differently. While high-quality firms may use umbrella branding as a quality reassuring mechanism, “fly by night” firms may exploit umbrella branding as a signal and sell low quality under a high price under the umbrella. Moreover, the effect of product tests on prices may be different for reputable and non-reputable firms. To account for this we separate the sample into two groups: brands that in the past showed better than full-sample median quality, and brands that showed worse than full-sample quality. The estimation results for the groups of products not tested before are shown in Tables 6 and 8 and in Figure 3 and Figure 4. For products already tested the results are shown in Tables 7 and 9.

The results show a positive and significant effect of grade 1 products on prices of umbrella brands that is more pronounced for brands with a good reputation history. The effect for brands worse than full-sample median quality (not tested before) is significant at a 5% significance level. An interesting behaviour is shown for products of grade 5 of reputable firms. They experience a price increase (only products not tested before). This suggests that these firms are exploiting their good reputation in the past, and because prices also signal quality, they seem to capture the uninformed consumers and sell their low quality product at a high price. If they would lower the price of a product that resulted to be of bad quality in the test, then they would signal to consumers the quality deterioration, also informing those not yet informed via the quality test result. By raising the price, they can still rely on their reputation for high quality and price-signal high quality to consumers unaware of the product test result. Note that the test result is for another product under the umbrella, which makes it even more plausible that not all consumers are aware of the bad test result for the base product. The estimated effect for reputable firms for products of grade 1 is again in accordance with our expectations, remains positive but smaller for products already tested. The test results seem to reinforce the reputational premium the firms will demand. For grade 5 products however the effect turns negative, which is a plausible effect, because for products already tested there is a larger share of informed consumers in the market, and consequently the reputable firm cannot any longer keep asking a high price as a signal for high quality as compared to the situation where products are not tested before.

For brands with worse than median quality, we find it puzzling that the effects are larger in the case of the sample, which includes already tested products. A possible explanation might be the use of mixed strategies in quality (Hoerner, 2002), which is associated with

randomized prices, such that there is not a clear prediction we can make between the two situations (products not tested versus already tested).

Overall the results confirm that umbrella branding effects are stronger for reputable firms and that umbrella branding is used differently by different kind of firms. The fact that umbrella effects arise mainly to a larger extent for reputable firms suggests that umbrella effects are preponderant for more reputable firms, meaning umbrella branding is successfully used as quality signal together only with reputation. The results show almost no effect for less reputable brands. We see a positive reputation effect of very good test results on prices of umbrella products, which supports the hypothesis that umbrella branding is a successful signal of quality.

Figure 2: Umbrella effects

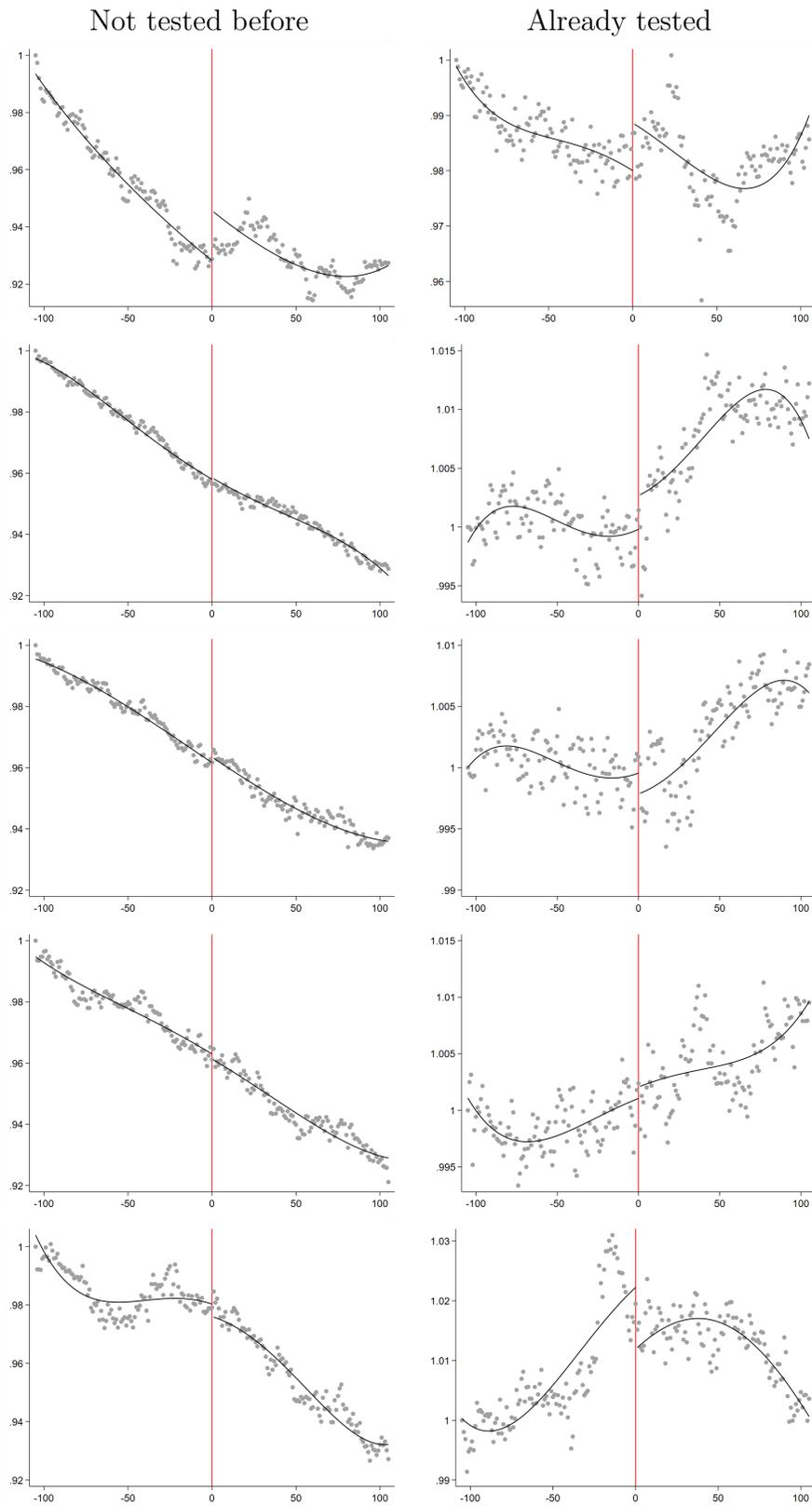


Table 4: Umbrella effects (not tested before)

	(1)	(2)	(3)	(4)	(5)
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
$1[t > 0]$	0.0174*** (0.00246)	0.000491 (0.00134)	0.00181 (0.00189)	-0.00162 (0.00341)	-0.00429 (0.00312)
t	-0.000471*** (0.0000452)	-0.000322*** (0.0000223)	-0.000368*** (0.0000279)	-0.000330*** (0.0000515)	-0.000187*** (0.0000467)
t^2	0.00000138* (0.000000638)	0.00000135*** (0.000000311)	0.000000271 (0.000000359)	-0.000000722 (0.000000597)	-0.00000499*** (0.000000585)
t^3	6.26e-09 (4.63e-09)	-1.59e-09 (2.14e-09)	6.82e-09** (2.46e-09)	2.28e-09 (4.48e-09)	-1.21e-08** (4.49e-09)
t^4	6.43e-11 (6.89e-11)	-9.18e-11** (3.22e-11)	1.26e-12 (3.62e-11)	6.28e-11 (5.44e-11)	3.69e-10*** (6.17e-11)
$1[0 \leq t \leq 4]$	-0.00898*** (0.00221)	-0.00182 (0.00183)	0.00124 (0.00231)	-0.000126 (0.00479)	0.00461 (0.00397)
N	32494	490364	247503	66254	25742

Table 5: Umbrella effects (already tested)

	(1)	(2)	(3)	(4)	(5)
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
$1[t > 0]$	0.00860*** (0.00175)	0.00287 (0.00154)	-0.00170 (0.00147)	0.00101 (0.00192)	-0.0103*** (0.00302)
t	-0.000188*** (0.0000315)	0.0000662** (0.0000230)	0.0000493* (0.0000238)	0.0000564 (0.0000295)	0.000256*** (0.0000497)
t^2	-0.00000142** (0.000000483)	0.00000181*** (0.000000310)	0.00000153*** (0.000000348)	-0.000000466 (0.000000392)	-0.00000261*** (0.000000623)
t^3	9.52e-09** (3.16e-09)	-3.43e-09 (1.98e-09)	-1.11e-09 (1.93e-09)	-1.87e-09 (2.91e-09)	-1.86e-08*** (4.96e-09)
t^4	2.12e-10*** (5.01e-11)	-1.49e-10*** (2.91e-11)	-1.03e-10** (3.38e-11)	7.35e-11 (3.93e-11)	9.96e-11 (6.80e-11)
$1[0 \leq t \leq 4]$	-0.00413* (0.00200)	-0.00453* (0.00220)	-0.000331 (0.00213)	-0.00189 (0.00245)	0.000501 (0.00319)
N	70685	2153044	989801	171754	44310

Figure 3: Umbrella effects for brands *better* than median quality

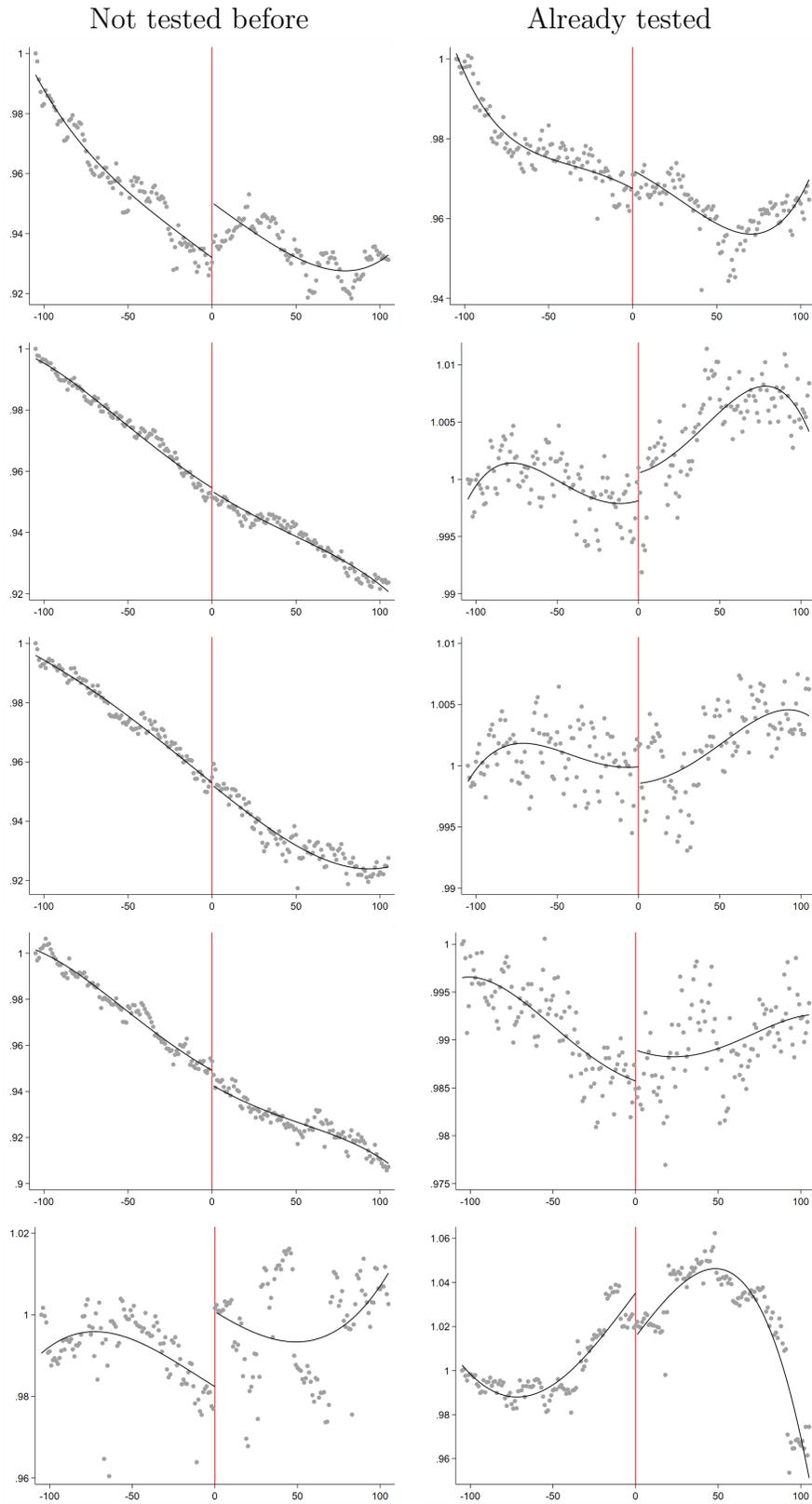


Table 6: Umbrella effects for brands *better* than median quality (not tested before)

	(1)	(2)	(3)	(4)	(5)
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
$1[t > 0]$	0.0183*** (0.00281)	-0.00107 (0.00121)	-0.000677 (0.00164)	-0.00638** (0.00242)	0.0183** (0.00649)
t	-0.000410*** (0.0000534)	-0.000348*** (0.0000207)	-0.000457*** (0.0000253)	-0.000415*** (0.0000445)	-0.000247* (0.000103)
t^2	0.000000375 (0.000000756)	0.00000128*** (0.000000298)	0.000000331 (0.000000303)	0.00000221*** (0.000000524)	0.000000840 (0.00000137)
t^3	3.34e-09 (5.62e-09)	-8.00e-10 (2.21e-09)	1.10e-08*** (2.30e-09)	3.69e-10 (4.41e-09)	2.29e-08* (1.00e-08)
t^4	1.45e-10 (8.25e-11)	-7.73e-11* (3.27e-11)	3.28e-11 (3.05e-11)	-1.26e-10* (5.46e-11)	-3.71e-12 (1.37e-10)
$1[0 \leq t \leq 4]$	-0.0103*** (0.00248)	-0.00230 (0.00169)	0.00365 (0.00188)	0.00301 (0.00300)	0.00475 (0.0103)
N	27430	360599	131453	18990	3798

Table 7: Umbrella effects for brands *better* than median quality (already tested)

	(1)	(2)	(3)	(4)	(5)
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
$1[t > 0]$	0.00450* (0.00189)	0.00243 (0.00157)	-0.00135 (0.00196)	0.00324 (0.00252)	-0.0198* (0.00862)
t	-0.000220*** (0.0000373)	0.0000408 (0.0000236)	0.0000138 (0.0000307)	-0.0000623 (0.0000369)	0.000980*** (0.000141)
t^2	-0.00000189*** (0.000000569)	0.00000179*** (0.000000327)	0.00000111* (0.000000451)	0.00000133** (0.000000491)	-0.00000151 (0.00000205)
t^3	4.34e-09 (3.80e-09)	-2.20e-09 (2.06e-09)	1.65e-09 (2.61e-09)	2.56e-09 (3.47e-09)	-0.000000103*** (1.31e-08)
t^4	3.02e-10*** (5.86e-11)	-1.47e-10*** (3.00e-11)	-8.31e-11 (4.43e-11)	-6.15e-11 (4.80e-11)	-2.61e-10 (2.05e-10)
$1[0 \leq t \leq 4]$	-0.00275 (0.00187)	-0.00421 (0.00230)	0.0000322 (0.00268)	-0.00421 (0.00350)	-0.000479 (0.00959)
N	51906	1709944	657898	75749	9706

Figure 4: Umbrella effects for brands *worse* than full-sample median quality

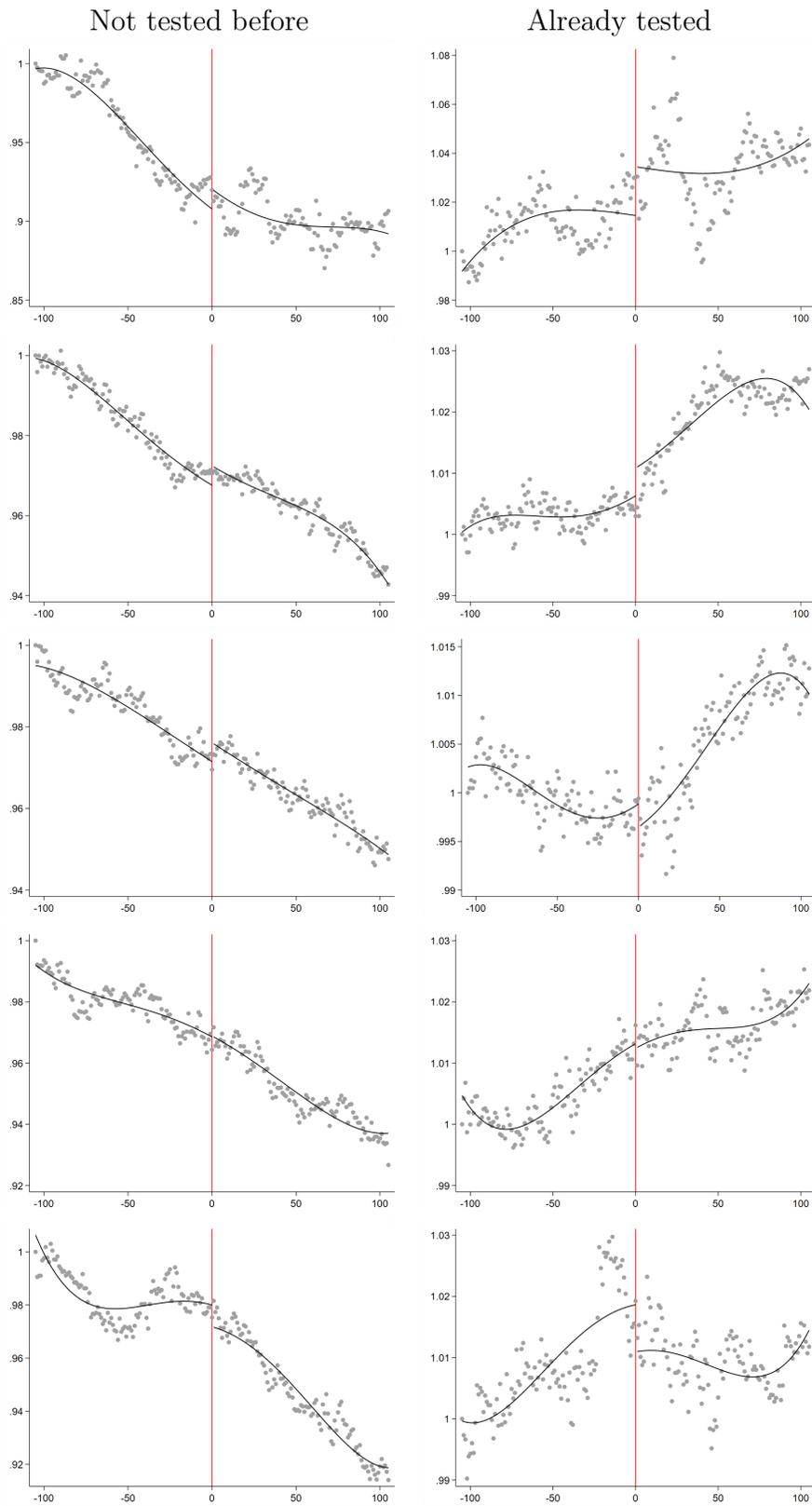


Table 8: Umbrella effects for brands *worse* than median quality (not tested before)

	(1)	(2)	(3)	(4)	(5)
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
$1[t > 0]$	0.0125* (0.00522)	0.00482 (0.00353)	0.00463 (0.00334)	0.000295 (0.00459)	-0.00821* (0.00323)
t	-0.000802*** (0.0000743)	-0.000250*** (0.0000537)	-0.000266*** (0.0000500)	-0.000296*** (0.0000665)	-0.000177*** (0.0000489)
t^2	0.00000684*** (0.000000956)	0.00000155* (0.000000697)	0.000000203 (0.000000599)	-0.00000190* (0.000000786)	-0.00000600*** (0.000000594)
t^3	2.21e-08** (7.05e-09)	-3.77e-09 (4.48e-09)	2.15e-09 (4.41e-09)	3.05e-09 (5.60e-09)	-1.82e-08*** (4.65e-09)
t^4	-3.71e-10*** (1.00e-10)	-1.32e-10* (6.63e-11)	-3.44e-11 (6.18e-11)	1.39e-10 (7.11e-11)	4.34e-10*** (6.06e-11)
$1[0 \leq t \leq 4]$	-0.00170 (0.00468)	-0.000499 (0.00484)	-0.00149 (0.00448)	-0.00139 (0.00660)	0.00459 (0.00436)
N	5064	129765	116050	47264	21944

Table 9: Umbrella effects for brands *worse* than median quality (already tested)

	(1)	(2)	(3)	(4)	(5)
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
$1[t > 0]$	0.0199*** (0.00506)	0.00456 (0.00261)	-0.00239 (0.00256)	-0.000741 (0.00234)	-0.00769*** (0.00230)
t	-0.000100 (0.0000687)	0.000164*** (0.0000410)	0.000120** (0.0000391)	0.000150*** (0.0000378)	0.0000522 (0.0000351)
t^2	-0.000000120 (0.000000816)	0.00000189*** (0.000000495)	0.00000238*** (0.000000450)	-0.00000189*** (0.000000449)	-0.00000291*** (0.000000452)
t^3	2.38e-08*** (5.83e-09)	-8.20e-09* (3.67e-09)	-6.58e-09 (3.39e-09)	-5.38e-09 (3.81e-09)	5.00e-09 (3.41e-09)
t^4	-3.59e-11 (7.62e-11)	-1.57e-10** (5.07e-11)	-1.44e-10** (4.72e-11)	1.80e-10*** (4.47e-11)	2.01e-10*** (4.47e-11)
$1[0 \leq t \leq 4]$	-0.00795 (0.00587)	-0.00577 (0.00308)	-0.00105 (0.00337)	-0.0000639 (0.00263)	0.000776 (0.00245)
N	18779	443100	331903	96005	34604

6 Discussion and Conclusion

This article examines whether reputation is leveraged across products sold under a common brand name. We investigate price changes in umbrella brand products after the quality of a product sold under the same name has been disclosed by the publication of product test results. We find support for the role of umbrella branding in transmitting information about quality across a wide range of markets. Descriptive evidence shows that umbrella brand products are associated with a higher quality compared to single brand products.

Estimation of a RDD type model around the event time shows that very good test results

leads to a price increase for other non-tested umbrella products, whereas prices of bad quality products decrease. The effects are more pronounced for reputable firms, suggesting that umbrella branding is an effective means for multi-product firms to leverage reputation across product categories. These results emphasize the importance of brand reputation in experience goods markets. The significant umbrella effects suggest an important externality in the market, arising from the indirect effect of the information disclosure that is spread through umbrella products. Umbrella branding has a quasi multiplier effect. This has important implications for the relevance of these test results, meaning that they are an important complementary mechanism to the market mechanisms (price, reputation, warranties) to sustain quality, with umbrella branding reinforcing the information disclosure effects.

Other possible implications relate to the welfare effects. The observed price increases imply a welfare loss for uninformed consumers, - consumers, that now also have to pay high prices for very bad products of reputable firms.

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Table 10: Umbrella brands with more than 4 products in the sample

Brand	N	Brand	N	Brand	N	Brand	N
Samsung	91	Olympus	15	Archos	8	Pentax	6
Philips	90	Bose	13	Garmin	8	Sennheiser	6
Sony	86	Brother	13	Honor	8	Sonos	6
Panasonic	69	Joie	13	Ricoh	8	Alcatel	5
LG	53	Recaro	13	Rowenta	8	Beats	5
Canon	51	Severin	13	Amazon	7	Canton	5
Bosch	50	WMF	13	BenQ	7	Constructa	5
AEG	42	Dell	12	Caso	7	Dirt Devil	5
Miele	39	Gorenje	12	Cien	7	Edeka	5
Siemens	39	JBL	12	Clatronic	7	Fitbit	5
HP	38	Maxi-Cosi	12	Fujifilm	7	Gardena	5
Acer	33	Technisat	12	GoPro	7	Jane	5
Huawei	32	Yamaha	12	Kiddy	7	Jura	5
Grundig	29	DeLonghi	11	Melitta	7	Koenic	5
Lenovo	29	Microsoft	11	Osram	7	Lavera	5
Apple	27	Nivea	11	AVM	6	Medisana	5
Asus	26	Chicco	10	Balea	6	Neff	5
Nikon	25	HTC	10	Bomann	6	Netgear	5
Britax	22	Krups	10	Conrad	6	OK	5
Rossmann	20	TP-Link	10	Decathlon	6	Onkyo	5
Beko	19	Teufel	10	Denon	6	Proficook	5
Ikea	19	Abus	9	Google	6	Rollei	5
Bauknecht	18	Bauhaus	9	Lightme	6	Ryobi	5
Aldi	17	Gigaset	9	Makita	6	Telefunken	5
Braun	17	Hauck	9	Metabo	6	Today	5
Epson	16	Pioneer	9	Motorola	6	Toshiba	5
Liebherr	16	Telekom	9	Nuna	6	Vichy	5
Cybex	15	Trekstor	9	Obi	6	Weleda	5
Medion	15	Amica	8	Optoma	6	Zanussi	5