Was the economics of information approach wrong all the way?

Evidence from German grocery r(E)tailing

Svetlana Fedoseeva[a*]

Roland Herrmann[a]

Katharina Nickolaus[a]

[a]*Institute of Agricultural Policy and Market Research*

Justus-Liebig-University of Giessen

Senckenbergstr. 3, 35390 Giessen, Germany

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Abstract

The economics of information approach suggests that as online retailing matures, information asymmetry will enforce the reduction of price dispersion online as providers will operate in conditions close to perfect competition. The internet has already become a part of our life and shopping experience. In Germany, over 20% of all electronic, media and leisure-related products are bought online. The role of digital channels is expected to increase further, especially in the latecomer sectors. Grocery retailing is one of such sectors still in the making and the share of online players in retail revenues is expected to grow drastically by 2020. Since online food retailing has not been studied thoroughly and little is known about price levels and dispersion between online and offline markets, our study fills this gap by showing that despite the theoretical predictions price dispersion exist both between online and offline grocery providers as well as across online retailers.

Keywords

grocery retail, price dispersion, online players, offline players, e-commerce, multichannel retailers

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1 Introduction

Economics of information suggests that the introduction and development of online retailing can eventually assure a complete awareness of the buyers about the prices and establish information symmetry. This should decrease search costs of consumers and should, together with diminishing market entry costs and menu costs of the online sellers, lead to lower price levels, reduced price dispersion and increased market efficiency (Biswas, 2004). Yet empirical studies show that this is not necessarily what happens in reality: prices and dispersion online are sometimes found to be substantially higher than offline. The evidence at the level of individual product groups is, however, mixed and we still lack understanding about whether, how and why prices differ online and offline.

Bayley (1998) investigated prices for books, CDs and computer software in the late 1990s and concluded that the price level as well as price dispersion online is higher than offline. This finding was questioned two years later by Brynjolfsson and Smith (1999, 2000), who showed that prices in online stores, including prices for books and CDs, are on the average 9-16% lower than in conventional stores. Clay et al. (2002) contributed to the heterogeneity of results by stating that prices for books in online and in physical bookstores are on the average the same, once shipping costs by the online retailers are disregarded. Finally, Ancarani (2002) and Ancarani and Shankar (2004) noted that prices for books and CDs are lower online if shipping costs are ignored, but once shipping costs are added, prices are always higher online. Lee et al. (1999) compared prices for used cars online and offline and came to the conclusion that the online prices are higher. Later studies noted that Lee actually investigated different products and had no information regarding the quality of sold cars; hence his findings cannot be taken as conclusive. Morton et al. (2001) re-addressed the subject and concluded that online prices for cars are two percent lower than those of cars sold through conventional channels. Finally Erevelles et al. (2001) suggests that online unit prices are significantly higher at internet retailers, closing the vicious circle of all possible relationship between price levels online and offline.

Although no uniform conclusion regarding the price levels online and offline can be made from the studies mentioned above, they basically agree on one thing: price dispersion exists both between and within online and offline channels. Even for such homogeneous products as vitamins, price dispersion among retailers is very high (see Erevelles et al., 2001, or Pan et al., 2004, for a review). The same is true once multichannel retailers are addressed. Empirical studies typically agree that multichannel retailers have higher prices than pure online platforms, and price dispersion for multichannel retailers is even larger compared to pure online or offline retailers (Tang and Xing, 2001; Pan et al. 2002; Ancarani and Shankar, 2004).

The mixed evidence on price differences online and offline has sometimes been attributed to the early stage of development of the e-commerce. For instance, Bayley (1998) expects that as internet markets mature, information efficiency will improve in line with Bakos (1997) and will bring online markets to a situation close to perfectly competitive.

This paper aims to test whether predictions of the economics of information approach hold in times of actively developing and in some sectors already booming online commerce. The food and beverage industry is in the focus of our investigation. Although the role of e-channels in Germany is still below 10 percent of grocery retailing (Ernst & Young, 2014; Doplbauer, 2015), multichannel and pure online retailers are forecast to reach 30 percent of the market share by 2020 (Ernst & Young, 2014), and about 40 % of German internet users already buy or consider buying a part of their grocery lists online (Fittkau & Maaß, 2014), making online grocery retailing a promising and non-negligible part of the German e-commerce.

Offline pricing in grocery retailing has been intensively analysed (Herrmann et al., 2005; Fassnacht et al. 2012; Loy and Scharper, 2014) and consumer behavior across online and offline stores has been addressed by a few studies (Chu et al., 2008; Chu et al., 2010; Dawes and Nenycz-Thiel, 2014; Melis et al., 2015). Little is known, however, about the pricing on- and offline for the case of a food sector, which differs from other sectors in a number of ways, making knowledge we have about e.g. books and CDs retail poorly transferrable to grocery shopping (see Hoyer et al., 2013). Doplbauer (2015), Fittkau & Maaß (2014), Gladding (2016) and Ernst & Young (2014) provide us with first insights into the present and the future of grocery e-commerce, outlining how strategically important the decision to go online might be (more to it in Section 3) and giving an impulse to initial research that aims to shed light on price setting in online grocery markets.

Lind (2013) focuses on the dynamic pricing in online coffee retailing, including the difference in price levels between individual retailers, price rigidity and the role of promotions in internet retailing. Her sample includes daily price data for ten coffee products from three online retailers. Results reveal strong price dispersion across retailers. Lebensmittel.de turned out to be the most expensive retailer, followed by Amazon.de and a multichannel retailer Real.de. Nevertheless, a few items were available at the lowest price at Lebensmittel.de, which was also found to be a retailer with the most flexible prices. Nickolaus (2015) compares prices of Lebensmittel.de to major German online and offline grocery retailers. The analysis includes a basket of groceries and suggests that there are clear discrepancies in price levels of individual retailers across all product groups. Prices set online are on average higher than offline; at the same time some online retailers deviate from this pattern and set prices as low as offline discounters. This study, however, differentiated only between online and offline retailers, overlooking that some of them are present in both channels and hence are multichannel retailers. Grein and Herrmann (2016) analyse prices of various chocolate products over time and eight online and multichannel retailers in an

attempt to figure out whether (i) major retailers price homogenous products identically; (ii) prices vary between pure online retailers and multichannel retailers; (iii) prices online and offline differ and (iv) if online prices are flexible. To address these questions authors apply statistical tools and come to the conclusion that prices online and offline differ and price dispersion can be found in pure online and multichannel retailing. Furthermore, they conclude that prices online are very rigid with the exception of Lebensmittel.de that adjusted prices a few times over the sample period. These studies provide us with first and very valuable insights into price-setting behavior of different types of retailers, yet they typically limit their methodology to the tools of descriptive and inductive statistics and hence leave some room for a more detailed investigation.

We fill this gap in the literature by quantifying the extent to which price levels (and dispersion) differ within and between on-, offline and multichannel players, both descriptively and using econometric techniques, based on a cross-section of sixteen grocery items sold by major German retailers.

The remainder of the paper is structured as follows: Section 2 provides some theoretical reasons why we might not observe price convergence and pricing at the level of marginal costs online. Section 3 briefly summarizes what we know about German grocery retailing by now. Section 4 provides information about the sample, e.g. stores and products included in the analysis, shows descriptive statistics and undertakes first comparisons between different groups of retailers with respect to their price levels and price variations. Section 5 proposes an econometric solution to quantify these price discrepancies and reports results of the analysis. Section 6 concludes.

2 Why is information efficiency supposed to result in efficient markets, and why is it not?

The economics of information approach makes a very clear prediction regarding the development of prices across retailers once e-commerce matures. Electronic marketplaces should reduce inefficiencies caused by consumer search costs and limit the ability of retailers to extract monopolistic profits: as information is distributed more efficiently, the 'opportunities for fat and easy profits' shrink and so does price dispersion among e-tailers (Bakos, 1997). If online shopping is easier than obtaining goods via conventional channels, the competitive pressure should push the online prices down compared to the prices in offline stores (Clay et al. 2002; Grover et al., 2006). And if internet competition brings about a 'nearly competitive market', in which the location of retailers is irrelevant and consumers are fully informed about prices and product offerings, retailers end up making zero economic profit (Brynjolfsson and Smith, 2000: 563).

Yet empirical studies suggest that neither of these predictions is flawless: we neither observe online retailers being cheaper than traditional offline stores (Evervelles et al. 2001), nor do we see online prices converging between online providers and eventually

approaching their level of marginal costs (Brynjolfsson and Smith, 2000; Clay et al. 2002; Cavallo, 2017; Gorodnichenko and Talavera, 2017). What we do observe is that there is a wide range of prices for similar (or even homogenous) goods on the market and those prices and hence price discrepancies are sticky, both offline (Herrmann et al., 2005; Loy and Schaper, 2014) and online (Tang and Xing, 2001; Berka et al., 2011; Gorodnichenko et al., 2014). All this suggests that something went wrong and information symmetry promised by the e-commerce got lost somewhere on the way of the online market maturing. Alternatively, the underlying assumption could be way too simplified.

The studies cited above agree in one thing: the more information consumers have and can use in their decision making, the better. The very first criticism of such short-sighted thinking was attempted by Ackoff (1967), who used managerial decision-making as an example to show that information has a dark side, and that 'more' is not always equal to 'better'. According to Grover et al. (2006), overload, uncertainty and equivocality are the main 'dark' facets of information that might lead to price dispersion online. Some consumers might use the price of a product as a proxy for its quality, if information about the quality of a product is uncertain (Tellis and Gaeth, 1990) or when the amount of information available is too high (Chang and Wildt, 1996). Similarly, having to deal with a large amount of alternatives leads to a lower effectiveness of decisions (Keller and Staelin, 1987; Lee and Lee, 2004) as such an information overload imposes a cognitive burden on the receiver (Hiltz and Turoff, 1985). Equivocality of information goes hand-in-hand with ratings and information-sharing platforms that consumers may use to communicate their satisfaction about their purchases. In the digital era when all online platforms have such evaluation tools, conflicting views and feedbacks are unavoidable. This ambiguity might be further passed on to other consumers, whose effectiveness of decision-making might be hindered by high variation in available ratings and evaluations (Koufteros et al., 2005). As a result, the more individual quality perceptions differ among individual consumers, the higher is the discrepancy in their willingness to pay for a certain product, and the higher price dispersion online will be (Grover et al., 2006).

The equivocality characteristic of information brings us to the next aspect of price-setting: not only availability of price information and quality of price-related information may affect the way information efficiency is affected in the digital era, also consumers and the way they define their utility functions and set their priorities in the search process are decisive.

Having access to perfect information and being perfectly informed are different things. Although information online becomes increasingly easy to find, consumers have to be prepared to spend a certain amount of time and effort on their search (Grover et al., 2006). The way market participants manage information is another major issue that is worth considering when we discuss the existence of price dispersion in times of almost perfect information. Already back in 1961 Stigler postulated that a costly search leads to a limited selection of stores to compare prices, and price dispersion can occur. Diamond (1971)

pointed out that for price dispersion to exist there must be some heterogeneity among buyers and sellers: once customers are different in their search costs, there will be eventually 'shoppers' who always find cheapest prices. The others will shop randomly, paying either low or high prices (Lach, 2002). As a result, even small search costs can lead to substantial price dispersion (Pratt et al. 1979), which is a natural result of consumers' search functions (Urbany et al., 1996).

Heterogeneity of consumers and the role of price and non-price factors play an important role in price levels and dispersion across retailing channels. If firms provide their customers with a rich flow of non-price information, the online channel does not increase price sensitivity of a customer (Lynch and Ariely, 2000). The increasing quality information provided to consumers can lead to lower price sensitivity and higher prices (Ancarani 2002). If search costs for obtaining information about certain non-price and non-sensory attributes of a product are lower online than offline, the importance of price in online retail might go down, making consumers less price-sensitive (Degeratu et al., 2000).

Furthermore, consumer preferences might predefine the way retailers are perceived and may have an effect on their pricing and non-price strategies. Even completely homogenous products sold by different sellers might be seen by customers as differentiated products as sellers' heterogeneity is passed on to the products (Lach, 2002). Sorensen (2000) points out that even products with identical physical characteristics (such as prescribed drugs) might be considered differentiated from the consumer point of view if they are sold in different stores. This finding can be traced back to the classical studies of Hotelling (1929) and Chamberlin (1933), in which products only varied in their location but were perceived as differentiated. More recent studies often name service differentiation as a source of price discrepancies (see e.g. Shapiro and Varian, 1999; Smith et al. 2000; Pan et al., 2002; or Cao and Gruca, 2004). Anania and Nistico (2014) suggest that price differentials might reflect consumer's loyalty to a certain store, and the emergence of monopolistic competition is possible even when homogenous goods are traded.

According to Reichheld and Schefter (2000), loyalty is a key word for understanding why price formation online does not go the way information theory predicted. As they point out, "Internet is a very sticky place, price does not rule the web, loyalty does" (p. 17). Nevo (2010) suggests that we cannot properly explain the heterogeneity of choices consumers make with standard consumer attributes. Consumer psychology and issues of trust and loyalty seem to play an important role in e-commerce. Organizing compelling shopping experiences (Novak et al., 2000; Menon and Kahn, 2002; Melis et al., 2015) and making the consumer's life easier through various loyalty programs that result in lock-in effects (Varian, 1999) and increasing switching costs (Smith et al. 2000) might affect consumer choices and competition online, as consumers are willing to pay a premium for reduced search costs provided by trust (Kocas, 2003; Grover et al. 2006). Having understood that, many retailers build their internet strategies putting trust in the center of it (Urban et al., 2000).

Finally, one should keep in mind that not only do consumers enjoy lower search costs of information about pricing in the digital era: retailers also benefit from lower costs of obtaining information about their customers (Pitt et al., 2001). Equipped with this information, retailers adjust their strategies accordingly to target their consumers and distinguish themselves from competitors by means of price - e.g. segmentation, dynamic and smart pricing, product and price versioning or price bundling (see Ancarani 2002 for more information) - or non-price competition, e.g. enhancing the portfolio of services provided to the customer and hence customer's satisfaction and loyalty (Wallace et al., 2004; Zhang et al., 2010). As a result, a situation exists in which a price for the same product between two online providers is different, yet both manage to make profits. The same is true for different pricing schemes implemented by multichannel providers. The same is also true for the difference between online and offline and also between two neighboring physical stores. After all, one just needs to look around: right across a street there might be a supermarket and a bakery shop, which are only a few meters apart but have more than 100% price difference for an identical bottle of water.

3 What does German online grocery retailing look like?

E-commerce still plays a moderate role in German food retailing. Only about 1% of retail revenues in the grocery segment come from pure internet players, while for non-food products this share is about 15% (Doplbauer, 2015). Once multichannel retailing is added, the share of e-commerce in food sector revenues increases to 6% and this number is expected to grow to 20% for multichannel and to 10% for pure internet retailers, which sums up to about 60 billion Euro by 2020 (Ernst & Young, 2013).

Grocery retailing in Germany is a latecomer in the online market. While electronic goods, media and leisure-related products make up about 20% of their sales online, the grocery market still lags behind. Yet given that food expenditures are the largest group (48.5%) of the basket of goods purchased on the day-to-day basis, online grocery retailing is an important part of the evolving German online market (Doplbauer, 2015).

Going online is an unavoidable path for conventional grocery stores in maintaining their competitiveness. According to the Ernst & Young outlook, it is only a matter of time until pure offline retailers become multichannel (Ernst & Young, 2013). As food retailing depends even more on trust and loyalty of its customers than any other sector, given that both take time to earn, conventional offline stores have already started embracing digitalization: Edeka, Rewe, Real and Netto already serve consumers on- and offline. Although specific characteristics of the grocery assortment make it easier for retailers who are already active offline to open up an online platform, in the internet these retailers have to compete with a different type of online providers – international big players such as Amazon and Ebay where most of non-food shopping has typically been done before (Fittkau & Maaß, 2014). These online players are highly competitive as they also already gained the trust of their consumers

and have capacities to extend their assortment by mobilizing capital and using high innovation capabilities to experiment and establish on the market (Ernst & Young, 2013). Smaller firms that use big players as a selling platform might benefit from their positive reputation and overcome the high entry barriers (in terms of trust) for newcomers in the online market.

With the decreasing profitability of store surfaces, the large stores gradually re-allocate their facilities outside of city centers or in the internet, leaving their centrally located stores to concentrate on fresh products and those important for immediate everyday consumption. The online assortment is expected to grow, serving the needs for those who prefer groceries to be delivered and opt for the scheduled purchases. Convenience and the joy of a digital experience, avoiding after-work queues, being free from the stores' opening hours and a large choice of specialties and products that are difficult to find elsewhere are the major factors that bring consumers online (Fittkau and Maaß, 2014). These attributes reflect two major target groups of online retailers: families with two working parents and children, who typically buy in bulk and do not mind delivery costs, and the gourmet-group: households with high purchasing power who search for something special and who are on the average less price sensitive (Ernst & Young, 2013). A person shopping for groceries online is likely to belong to one of these groups, be a male of 20-40 years old, a frequent buyer of organic products, who gets his groceries in Rewe, when offline (Fittkau and Maaß, 2014). The consumers who buy food at Aldi, Lidl or Kaufland are the least active online. Although the Ernst and Young (2013) survey reports that 23 % of their respondents expect to use delivery services more often due to their age and their health condition, Doplbauer (2015) suggests that surfing pensioners are still rather rare. Furthermore, this study points out that there is a certain U-shaped relationship between shopping online and the income level. This reflects in the reasons that people provide for or against buying their groceries online: in the GfK survey 57% of respondents named saving money as their major reason for shopping online (Doplbauer, 2015). In the survey conducted by Ernst & Young (2013), 39% of respondents stated that they buy groceries online due to low prices. At the same time, over 60% reported that high prices are the reason why they do not buy food online.

Apart from price reasons that typically draw consumers away from online markets are difficulties to assess quality and freshness of products online, missing the experience of going shopping or being satisfied with the way things are and wishing for no changes. While the experience factors can probably be only reversed in the long run by substituting the experience of offline shopping by a positive experience of shopping online, major online platforms actively engage in creating technologies that would guarantee that groceries being delivered in their best form to assure the high quality and to increase assortment to a wider range of products, including fresh and chilled to the today's basket that is focused on confectionery, wine, coffee and specialties. Succeeding in non-trivial grocery logistics might contribute a lot to their establishment on the online grocery market currently being developed. Someone who manages to pull through the innovations needed and to build up a

trust network based on increasingly available consumer information might have the chances to outperform rivals in hard price and non-price competition.

4 Sample and descriptive statistics

In the empirical part we use data collected by Nickolaus (2015), who analyzed pricing strategies by Lebensmittel.de and compared its prices with those of major online and offline retailers. These data include three sets of observations: time-series data on Lebensmittel.de prices over a large nomenclature of products (13.03-10.06.2015) and two cross-sectional samples for prices in online and offline stores, collected on May 19 and June 5 respectively. In our study we focus on price data on thirteen retailers[1] and sixteen products, which were available for most of retailers (Appendix A). High price rigidity in offline and online grocery retailing (see e.g. Berka et al., 2011; Loy and Schaper, 2014; Grein and Herrmann, 2016) assures that our results come from differences in store characteristics, not days of data collection.[2] Table 1 demonstrates the products in our sample, sorted according to an ascending mean price and some descriptive statistics.

Table 1. Descriptive statistics for 16 products of our sample [here]

In line with Pratt et al. (1979) and Lach (2002), the higher the mean price of a product, the lower seems to be the price dispersion across retailers as measured by the coefficient of variation. As the search is more valuable for high-price goods given that search costs are low relative to the high price of the product, more searching is undertaken when high-value products are bought. Table 2 breaks down the dispersion of price data according to the channel the retailer used to communicate the price (online or offline).

Table 2. Price levels and dispersion across retailers setting prices online and offline [here]

From Table 2, two interesting characteristics of German food retailers are readily apparent:

i) Prices for food products sold on the internet are on average 16 % higher than prices of identical items sold via conventional channels.

ii) Price dispersion online is higher than offline. There are substantial and systematic differences in prices across online retailers. Prices posted on the internet differ on average by 18 % across the 16 products of our sample.

[1] The retailers include Penny and Kaufland as pure offline retailers, Amazon.de, Ebay, Lebensmittel.de and Allyouneedfresh as pure online retailers and Rewe, Edeka, Real, Netto and Mytime.de as multichannel retailers. For the last group data include both on- and offline prices for Edeka and Rewe, only online prices for MyTime.de and only offline prices for Netto and Real.

[2] For Lebensmittel.de, which was twice named as a retailer with flexible prices by earlier studies (Lind, 2014; Grein and Herrmann, 2016), Nickolaus (2015) also includes data for June 5, 2015, the day of the offline data collection. Using the data from 05.06.2015 for Lebensmittel.de in empirical part does not change results.

If we additionally address a potentially important characteristic of some retailers, namely having both channels to sell their products, and split retailers into three groups of pure online and offline retailers and multichannel retailers (Appendix B), we can show that the prices of pure online retailers are on average 14 % higher than those of multichannel retailers. Multichannel retailer prices are in turn on the average 4% more expensive than those of pure offline retailers (although some products are cheaper at multichannel retailers). This leads us to a following observation, which we also empirically test in the following section:

iii) Prices of the multichannel retailers are on the average higher than those of purely conventional retailers and lower than in a pure online store (Figure 1).

Figure 1. Average deviations from a sample mean price across different types of retailers [here]

5 Empirical analysis

In the first model we express prices as a function of a full set of product-specific fixed effects and with dummies for all the retailers in our sample. The reference group here is Amazon for two reasons: (i) Most of the food and beverage items in Germany that are purchased online are bought through this platform (Fittkau & Maaß Consulting, 2014). (ii) Amazon has a record of being the most expensive e-store (see Clay et al., 2002, for the case of books). Table 3 reports the estimated outcomes.

Table 3. Estimation results of a cross-section model with a full set of product-specific coefficients and retailer fixed effects [here]

The high explanatory power of the model is not surprising given that we control for product heterogeneity[3]: all product-related fixed effects are highly statistically significant and their magnitudes are plausible. Our results confirm earlier studies suggesting that Amazon sets the highest prices. However, in our sample Amazon is not the only leader in high prices: Ebay and Lebensmittel.de seem to be equally expensive with the prices of all other retailers being significantly lower than the prices set by Amazon. Prices of conventional stores are on the average about one Euro lower compared to Amazon prices. Rewe online prices are also close to the level of offline retailers.

Table 4 shows the results of a Wald test that we apply to assess whether differences in prices between the stores other than Amazon.de are statistically significant. p-values are

[3] Since the large proportion of the variation in prices comes from the product price dispersion, we additionally calculated the eta-squared, which is 0.041 when prices are explained by individual retailers, 0.024 when we split retailers in two groups depending on whether the prices were collected for on- or offline and 0.030 if we additionally account for multichannel retailers.

reported and the results of the test with H_0: $p_i = p_j$ with a p-value under 0.1 are shaded in grey.

Table 4. The Wald test of equality between individual retailer-specific coefficients (symmetric, both sides reported) [here]

These results vaguely point out that a certain asymmetry between online and offline prices exists, although e.g. estimates for Rewe Online, MyTime and Allyouneedfresh do not (at all or seldom) significantly deviate from the estimates obtained for the prices of offline retailers. To provide a clearer view on how much online prices exceed prices paid offline, Table 5 reports results of an estimation in which the effect of online retailing as compared to offline retailing is reported. One needs to keep in mind, however, that in this regression we do not include any information about retailers possibly having both channels of sales (as e.g. Rewe and Rewe Online). Online prices here are prices gathered on internet platforms of a retailer, irrespective whether the seller additionally has a conventional store. Offline prices, which are the reference groups, are prices collected in traditional stores, irrespective of whether the seller also has an internet platform. As before, we also control for product-specific effects in the model.

Table 5. Estimation results of a cross-sectional model with a full set of product-specific coefficients and a fixed effect for online retailers [here]

Table 5 suggests that online prices are on the average 45 cents higher than prices in conventional stores. Yet the results of our first estimation make it clear that retailers and their pricing are very heterogeneous and splitting them in just two groups might be too restrictive.

Given that having an online trading platform becomes a matter of competitiveness for classical offline retailers (Melis et al. 2015; Lee and Grewal, 2004) and most of retailers in our sample are active both online and offline, we report results in Table 6 that distinguish between prices of pure online providers and multichannel retailers in their on- and offline stores. The reference category is the pure offline retail store.

Table 6. Estimation results of a cross-sectional model with a full set of product-specific coefficients and various retailer fixed effects [here]

A pure online retailer's prices are by 72 cents higher than those of a pure offline retailer in our sample. This estimate is higher than the one obtained in Table 5, yet it is also lower than one would expect given the results of Table 3. The prices of Allyouneedfresh, which are close to the level of offline providers, seem to drag the prices of Amazon.de, Ebay and Lebensmittel.de down. Given that Amazon.de is the largest source for food and beverages purchases on the internet, it is likely that the average online price weighted by sales volumes and hence difference compared to conventional stores prices would be much higher. The multichannel providers seem to differentiate between their online and offline markets, with

prices in their online stores being set higher than in conventional stores, and prices in offline stores of multichannels not statistically significantly deviating from those of pure offline retailers. If we look back to Table 4 it becomes clear that multichannel retailers are also heterogeneous. For instance, Rewe and Edeka, the two retailers for which we can observe prices both online and offline, pursue different pricing strategies across their selling channels. While in the case of price estimates for Rewe we could not reject the hypothesis of their equality, we could reject the similar hypothesis in the case of Edeka.

If we exclude the most expensive product in our sample, the magnitude of the *Pure Online* coefficient goes down from 0.72 to 0.67 and the *Multichannel Online* coefficient declines from 0.23 to 0.19 (Model 1, Table 7). Once the cheapest product is excluded, the estimates of both coefficients go up to 0.74 and 0.24 respectively (Model 2, Table 7). This might be an indication that more expensive food and beverage items are priced with a larger margin online in absolute terms than cheaper products. The result however holds true when we consider logarithm of prices as a dependent variable. If we split the sample into two groups of products according to their mean prices and repeat our estimation for each group separately, some interesting results arise (Models 3 and 4, Table 7).

Table 7. Results of a cross-sectional model with sub-samples of products included and various retailer fixed-effects [here]

In Model 3, the coefficient related to Pure Online retailers is only 0.42, suggesting that on average prices for less expensive food products at pure online retailers lie about 42 cents above those at Penny and Kaufland. This result is however at least partially driven by the fact that many products of the 'cheaper' group were simply not available at Amazon.de or Ebay according to our data. Multichannel prices for this group of products do not statistically differ from pure offline prices. Once the more expensive group is analyzed, another picture emerges. Pure online prices are on the average almost 1 Euro more expensive than at a pure conventional offline store (and this is even with transportation costs excluded). Hence, despite the fact that higher prices of goods decrease the relative searching costs of comparing alternatives, pure online retailers (especially Amazon.de, Ebay and Lebensmittel.de) set higher prices on these goods than those at which they are available in conventional stores. Prices of online departments of multichannel retailers are also significantly higher for this group (0.37), while the offline prices of multichannel retailers cannot be differentiated from pure offline prices. This might be an indication that differentiated pricing strategies online and offline can target different consumer segments in food retailing. Once one drops the assumption that being online is only used to improve price comparison across various e-platforms and allows online consumers to minimize any cognitive processes related to purchase of a certain item and opt for simplicity of an online experience, even at a somewhat higher cost, the price dispersion online and offline and higher relative online prices in food retailing do not seem that illogical.

6 Conclusion

Despite the predictions of the economics of information approach price dispersion persists in offline and online retailing even in times of rapid digitalization when prices can be compared online in a matter of seconds. This study outlines that this is the case also for German grocery retailing. We show that dispersion is high and even absolutely homogenous products are sold at different prices at different stores at the same time.

Prices for groceries online are on the average higher than offline. Although this has already been stated by some earlier studies for non-food products (Bayley, 1998; Erevelles et al., 2001), it is somewhat counterintuitive, given that surveys often reveal that low prices are the reasons why people go online when buying food (Ernst & Young, 2013; Doplbauer, 2015). Yet, while search costs might be relatively low for expensive products, they might be also relatively high for moderate-value products. Since food products and beverages in our sample can barely qualify for luxury high-priced goods, it can at least to some part explain why price dispersion is high within and between different types of retailers. Searching for the best price available might simply take more time than some consumers are ready to invest. Furthermore, earlier research, which suggests that prices online are lower due to a whole range of sells-related services (e.g. consultations) that drop out when goods are sold via internet platforms (see e.g. Tang and Xing, 2001), deals with non-food products and its findings cannot be easily transferred to online grocery retailing.

Food retailing stands aside also when it comes to the pricing of multichannel players. For instance Tang and Xing (2001), Pan et al. (2002) and Ancarani and Shankar (2004) suggested that multichannel retailers have higher average prices than pure online retailers. Our data suggest that multichannel prices are lower than the prices of pure online retailers, irrespective of the way we define multichannel sellers. Prices of pure online providers (especially Amazon.de, Ebay and Lebensmittel.de) are substantially higher than prices of all other retailers. This result holds true irrespective of a model specification or products included in the sample. Given that prices we used for online retailers are free of shipping costs, it is easy to infer that the actual discrepancies in price levels between online and offline in food retailing might be even higher.

The success story of Amazon, which is the ultimate source of online food and beverage shopping for most Germans, shows how consumers' experience, switching costs and lock-in effects combined with relevant services expected from an online retailer can explain the readiness of consumers to pay a higher price for their products online, despite the prediction of the economics of information approach. Amazon and Ebay had a competitive advantage of being the first movers on this still developing online market. Although Melis et al. (2015) provide evidence that consumers tend to select the online store of the same chain as their preferred offline stores when they start buying groceries online, consumers, who had already made a positive experience with an online purchase of a non-food item at one of those pure e-retailer, might decide to buy the groceries there as well. Apparently, it is

convenient that an account is already created, the shipping address and the payment methods are saved and the delivery times and terms are known.

This study examines the grocery sector at a certain point of time. Although prices in food retail are sticky, providers online and offline might implement different strategies of price setting and follow different paths of price adjustments due to exogenous shocks, be that exchange rates or costs of production, when a long time span is considered. Given that our data does not allow us to address these issues, we encourage further research to include the dynamic aspect into the analysis of price dispersion in online and offline retailing.

7 Literature

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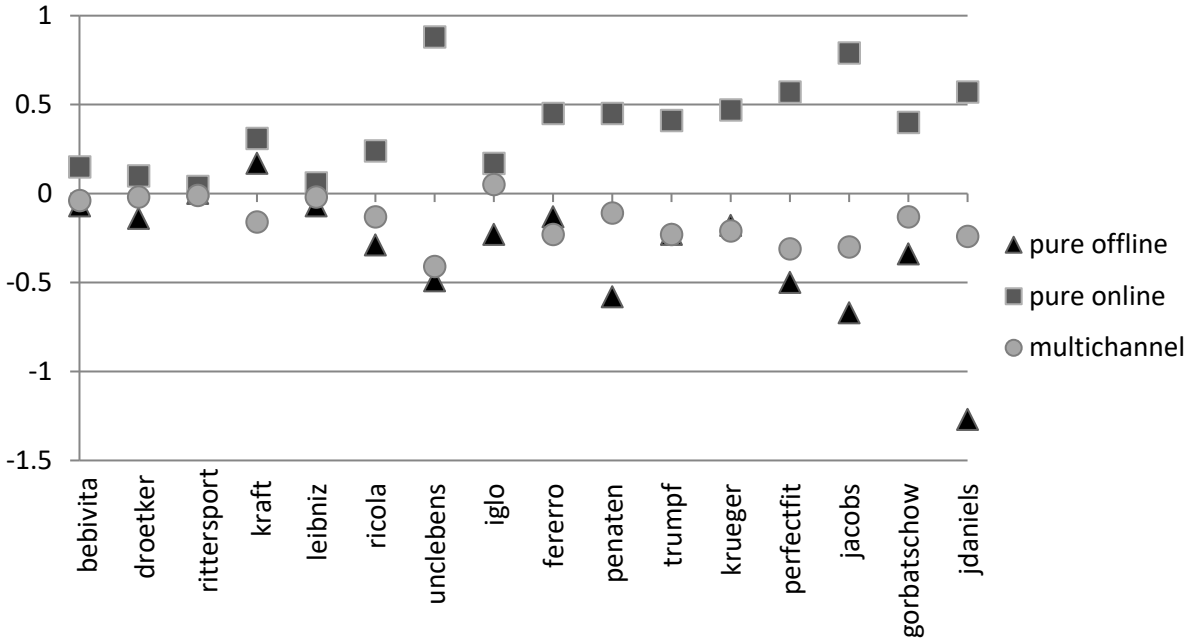
Figure 1. Average deviations from a sample mean price across different types of retailers



Notes: Demeaned average prices for three groups of retailers are compared to the sample average (zero line).

Table 1. Descriptive statistics for prices (Euro) in our sample

Product	Variable	Mean	Median	Min.	Max.	Std. Dev.	Disp.	Obs.
Bebivita, Apple-Banana, 190 g.	*bebivita*	0.72	0.65	0.99	0.65	0.11	0.16	9
Dr. Oetker, Baking Aroma Lemon, 4 p.	*droetker*	0.79	0.79	1.18	0.65	0.15	0.19	11
Ritter Sport Chocolate, Alpenmilch, 100 g.	*rittersport*	0.99	0.99	1.19	0.89	0.07	0.07	12
Kraft, Philadelphia Classic, Kräuter, 175 g.	*kraft*	1.47	1.39	2.17	0.88	0.34	0.23	10
Leibniz, Pick Up Choco, 140g.	*leibniz*	1.76	1.69	2.49	1.49	0.25	0.14	13
Ricola, Cranberry, 75 g.	*ricola*	2.04	1.94	2.79	1.75	0.32	0.16	10
Uncle Ben's, Express Mediterran , 250 g.	*unclebens*	2.18	1.72	5.64	1.65	1.15	0.53	12
Iglo, Filegro Müllerin Art, 250 g.	*iglo*	2.52	2.59	2.99	2.19	0.27	0.11	9
Ferrero, Nutella, 450 g.	*ferrero*	2.78	2.65	3.90	1.89	0.48	0.17	13
Penaten, Baby cream face and body, 100 ml.	*penaten*	2.90	2.89	4.17	2.29	0.59	0.20	12
Trumpf, Edle Tropfen in Nuss, 250 g.	*trumpf*	3.02	2.99	3.80	2.37	0.49	0.16	11
Krüger, Schoko Cappuccino, 500 g.	*krueger*	3.32	3.29	4.29	2.22	0.55	0.17	13
Perfect Fit, Active, 750 g.	*perfectfit*	3.95	3.79	6.32	2.79	0.92	0.23	11
Jacobs, Jakobs Krönung mild, grounded, 500 g.	*jacobs*	5.81	5.99	7.89	3.99	1.11	0.19	12
Vodka Gorbatschow, 700 ml.	*gorbatschow*	8.33	8.49	8.99	7.49	0.59	0.07	13
Jack Daniels Whiskey, 700 ml.	*jdaniels*	19.26	18.99	21.29	17.99	1.08	0.06	9

Note: Dispersion is defined as the coefficient of variation.
Source: Own computation.

Table 2. Price levels (Euro) and dispersion across retailers setting prices online and offline

	Offline retailers			Online retailers			Online-Offline		
	Mean	Median	Disp.	Mean	Median	Disp.	ΔMean	ΔMedian	ΔDisp.
bebivita	0.65	0.65	0.00	0.77	0.75	0.17	0.12	0.10	0.17
droetker	0.71	0.69	0.10	0.86	0.79	0.20	0.14	0.10	0.10
rittersport	0.99	0.99	0.00	0.99	0.99	0.11	0.00	0.00	0.11
kraft	1.39	1.39	0.23	1.59	1.39	0.25	0.20	0.00	0.02
leibniz	1.74	1.74	0.03	1.77	1.69	0.20	0.03	-0.05	0.17
ricola	1.86	1.84	0.06	2.17	2.11	0.17	0.31	0.27	0.11
unclebens	1.71	1.69	0.03	2.52	1.90	0.58	0.81	0.21	0.55
iglo	2.39	2.29	0.08	2.79	2.69	0.06	0.40	0.40	-0.02
ferrero	2.53	2.65	0.12	2.99	2.79	0.18	0.46	0.14	0.05
penaten	2.53	2.35	0.12	3.17	2.99	0.19	0.64	0.64	0.08
trumpf	2.69	2.69	0.10	3.21	3.29	0.16	0.53	0.60	0.06
krueger	3.24	3.29	0.04	3.39	3.49	0.22	0.15	0.20	0.19
perfectfit	3.37	3.22	0.19	4.27	3.99	0.21	0.90	0.77	0.02
jacobs	5.35	5.99	0.16	6.14	6.42	0.20	0.79	0.43	0.03
gorbatschow	7.91	7.74	0.06	8.70	8.95	0.04	0.79	1.21	-0.02
jdaniels	18.29	18.29	0.02	19.54	19.82	0.05	1.25	1.53	0.03

Note: Dispersion is defined as the coefficient of variation.
Source: Own computation.

Table 3. Estimation results of a cross-section model with a full set of product-specific coefficients and retailer fixed effects

	Price			Log(Price)		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
bebivita	1.54	0.29	0.00	-0.10	0.09	0.27
droetker	1.53	0.28	0.00	-0.03	0.09	0.73
ferrero	3.53	0.27	0.00	1.23	0.08	0.00
gorbatchev	9.08	0.29	0.00	2.34	0.08	0.00
iglo	3.39	0.30	0.00	1.17	0.09	0.00
jacobs	6.54	0.37	0.00	1.95	0.09	0.00
jdaniels	19.92	0.38	0.00	3.15	0.09	0.00
kraft	2.33	0.30	0.00	0.61	0.10	0.00
krueger	4.07	0.27	0.00	1.41	0.08	0.00
leibniz	2.51	0.27	0.00	0.77	0.09	0.00
penaten	3.63	0.28	0.00	1.26	0.08	0.00
perfectfit	4.64	0.33	0.00	1.55	0.09	0.00
ricola	2.74	0.27	0.00	0.91	0.08	0.00
rittersport	1.80	0.29	0.00	0.22	0.09	0.01
trumpf	3.73	0.26	0.00	1.30	0.08	0.00
unclebens	2.93	0.49	0.00	0.92	0.15	0.00
Edeka	-0.91	0.29	0.00	-0.29	0.09	0.00
Kaufland	-1.01	0.29	0.00	-0.30	0.09	0.00
Netto	-1.03	0.30	0.00	-0.32	0.09	0.00
Penny	-1.12	0.33	0.00	-0.29	0.10	0.00
Real	-1.19	0.29	0.00	-0.34	0.09	0.00
Rewe	-0.76	0.27	0.01	-0.21	0.08	0.01
Allyouneedfresh	-0.80	0.30	0.01	-0.28	0.09	0.00
Ebay	-0.46	0.35	0.20	-0.13	0.09	0.18
Edeka24	-0.66	0.29	0.03	-0.17	0.08	0.05
Lebensmittel.de	-0.04	0.34	0.91	0.02	0.09	0.81
MyTime	-0.84	0.28	0.00	-0.26	0.09	0.00
Rewe Online	-0.93	0.32	0.00	-0.27	0.09	0.00
Adj. R-squared	0.98			0.97		

Notes: Amazon.de is a reference category for retailers. Robust standard errors are reported.
Source: Own computation.

Table 4. An F-test of equality between estimated individual retailer-specific coefficients (symmetric, both sides reported)

	Edeka	Kaufland	Netto	Penny	Real	Rewe	Allyoune-edfresh	Ebay	Edeka24	Lebens-mittel.de	MyTime	Rewe Online
Edeka		0.40	0.31	0.25	0.04	0.14	0.47	0.06	0.07	0.00	0.54	0.88
Kaufland	0.40		0.86	0.53	0.18	0.01	0.17	0.02	0.01	0.00	0.15	0.68
Netto	0.31	0.86		0.60	0.24	0.01	0.13	0.02	0.01	0.00	0.12	0.58
Penny	0.25	0.53	0.60		0.75	0.04	0.13	0.02	0.02	0.00	0.13	0.41
Real	0.04	0.18	0.24	0.75		0.00	0.02	0.00	0.00	0.00	0.01	0.17
Rewe	0.14	0.01	0.01	0.04	0.00		0.73	0.20	0.44	0.00	0.42	0.29
Allyouneedfresh	0.47	0.17	0.13	0.13	0.02	0.73		0.18	0.38	0.00	0.81	0.51
Ebay	0.06	0.02	0.02	0.02	0.00	0.20	0.18		0.42	0.17	0.11	0.09
Edeka24	0.07	0.01	0.01	0.02	0.00	0.44	0.38	0.42		0.01	0.19	0.15
Lebensmittel.de	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.01		0.00	0.00
MyTime	0.54	0.15	0.12	0.13	0.01	0.42	0.81	0.11	0.19	0.00		0.58
Rewe Online	0.88	0.68	0.58	0.41	0.17	0.29	0.51	0.09	0.15	0.00	0.58	

Notes: H_0: $p_i = p_j$, in which p is an estimated retailer-specific coefficient from the estimated model, which results are reported in Table 3 (with level prices as a dependent variable). P-values are reported. All the p-values under 0.10 are shaded in grey. Amazon is omitted in the presentation as it is used as reference category in estimation, hence does not have a coefficient.

Source: Own computation.

Table 5. Estimation results of a cross-sectional model with a full set of product-specific coefficients and a fixed effect for online retailers

	Price			Log(Price)		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
bebivita	0.47	0.08	0.00	-0.41	0.04	0.00
droetker	0.54	0.08	0.00	-0.32	0.04	0.00
ferrero	2.53	0.12	0.00	0.94	0.04	0.00
gorbatchev	8.09	0.14	0.00	2.05	0.02	0.00
iglo	2.37	0.07	0.00	0.88	0.03	0.00
jacobs	5.55	0.30	0.00	1.66	0.06	0.00
jdaniels	18.91	0.33	0.00	2.85	0.03	0.00
kraft	1.29	0.12	0.00	0.31	0.07	0.00
krueger	3.08	0.15	0.00	1.12	0.05	0.00
leibniz	1.51	0.10	0.00	0.48	0.04	0.00
penaten	2.64	0.15	0.00	0.97	0.05	0.00
perfectfit	3.66	0.25	0.00	1.27	0.06	0.00
ricola	1.77	0.10	0.00	0.62	0.04	0.00
rittersport	0.77	0.08	0.00	-0.08	0.03	0.01
trumpf	2.73	0.13	0.00	1.01	0.04	0.00
unclebens	1.92	0.30	0.00	0.63	0.09	0.00
Online	0.45	0.08	0.00	0.13	0.02	0.00
Adj. R-squared	0.98			0.96		

Notes: “Offline” prices gathered from offline platforms (conventional stores) are the reference category.
Robust standard errors are reported.
Source: Own computation.

Table 6. Estimation results of a cross-sectional model with a full set of product-specific coefficients and various retailer fixed effects

	Price			Log(Price)		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
bebivita	0.46	0.11	0.00	-0.40	0.04	0.00
droetker	0.51	0.11	0.00	-0.32	0.05	0.00
ferrero	2.48	0.13	0.00	0.93	0.04	0.00
gorbatchev	8.04	0.16	0.00	2.04	0.03	0.00
iglo	2.36	0.11	0.00	0.88	0.04	0.00
jacobs	5.49	0.30	0.00	1.66	0.06	0.00
jdaniels	18.86	0.32	0.00	2.85	0.03	0.00
kraft	1.25	0.14	0.00	0.31	0.07	0.00
krueger	3.03	0.15	0.00	1.11	0.05	0.00
leibniz	1.46	0.13	0.00	0.48	0.04	0.00
penaten	2.59	0.15	0.00	0.97	0.05	0.00
perfectfit	3.60	0.25	0.00	1.26	0.06	0.00
ricola	1.69	0.12	0.00	0.61	0.04	0.00
rittersport	0.73	0.11	0.00	-0.08	0.03	0.03
trumpf	2.67	0.14	0.00	1.00	0.04	0.00
unclebens	1.87	0.28	0.00	0.62	0.09	0.00
Pure Online	0.72	0.14	0.00	0.20	0.04	0.00
Multichannel Online	0.23	0.11	0.04	0.06	0.03	0.04
Multichannel Offline	0.07	0.09	0.47	0.00	0.03	0.93
R-squared	0.98			0.96		

Notes: Pure offline retailers are a reference category for retailers. Robust standard errors are reported.
Source: Own computation.

Table 7. Estimation results of a cross-sectional model with sub-samples of products included and various retailer fixed-effects (Price in Euro as a dependent variable)

	(1)			(2)			(3)			(4)		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
bebivita	0.49	0.10	0.00				0.59	0.08	0.00			
droetker	0.54	0.11	0.00	0.50	0.12	0.00	0.65	0.09	0.00			
ferrero	2.52	0.12	0.00	2.47	0.13	0.00				2.36	0.17	0.00
gorbatchev	8.07	0.16	0.00	8.03	0.16	0.00				7.92	0.19	0.00
iglo	2.39	0.10	0.00	2.36	0.11	0.00	2.45	0.10	0.00			
jacobs	5.53	0.30	0.00	5.49	0.30	0.00				5.37	0.31	0.00
jdaniels				18.84	0.32	0.00				18.69	0.33	0.00
kraft	1.28	0.13	0.00	1.24	0.14	0.00	1.36	0.13	0.00			
krueger	3.06	0.15	0.00	3.02	0.15	0.00				2.91	0.18	0.00
leibniz	1.49	0.12	0.00	1.45	0.13	0.00	1.60	0.11	0.00			
penaten	2.62	0.15	0.00	2.58	0.15	0.00				2.46	0.17	0.00
perfectfit	3.64	0.25	0.00	3.59	0.25	0.00				3.46	0.26	0.00
ricola	1.73	0.12	0.00	1.68	0.12	0.00	1.85	0.12	0.00			
rittersport	0.76	0.11	0.00	0.72	0.12	0.00	0.86	0.09	0.00			
trumpf	2.71	0.14	0.00	2.67	0.14	0.00				2.54	0.18	0.00
unclebens	1.90	0.28	0.00	1.86	0.28	0.00	2.02	0.27	0.00			
Pure Online	0.67	0.13	0.00	0.74	0.14	0.00	0.42	0.18	0.03	0.97	0.20	0.00
Multichannel Online	0.19	0.10	0.07	0.24	0.11	0.04	0.09	0.08	0.24	0.37	0.19	0.06
Multichannel Offline	0.04	0.09	0.66	0.07	0.10	0.48	0.02	0.08	0.81	0.11	0.17	0.53
R-squared	0.94			0.98			0.69			0.98		

Notes: Pure offline retailers are a reference category for retailers. Robust standard errors are reported .Model (1) is estimated for a sample that excludes *jdaniels*. Model (2) is estimated for a sample that excludes *bebivita*. Model (3) is estimated for eight products with prices below the sample mean. Model (4) is estimated for eight products with prices above the sample mean.

Source: Own computation.

Appendices

Appendix A. Prices across sample products and retailers (Euro)

	Edeka	Kaufland	Netto	Penny	Real	Rewe	Allyoune-edfresh	Ebay	Edeka24	Lebens - mittel.de	MyTime	Rewe Online	Amazon	Mean
bebivita	0.65	0.65	0.65	na	0.65	na	0.75	na	0.79	0.99	0.69	0.65	na	0.72
droetker	0.79	0.65	0.65	na	0.69	0.79	0.69	na	0.89	1.18	0.79	0.79	0.79	0.79
rittersport	0.99	0.99	0.99	0.99	0.99	0.99	0.89	1.00	0.99	1.19	0.89	0.99	na	0.99
kraft	0.88	1.39	1.39	1.89	1.39	1.39	1.39	na	na	2.17	1.39	1.39	na	1.47
leibniz	1.79	1.69	1.69	1.69	1.79	1.79	1.59	1.49	1.89	1.69	1.49	1.75	2.49	1.76
ricola	1.79	1.75	na	na	1.99	1.89	1.79	2.32	na	2.79	1.99	1.89	2.22	2.04
unclebens	1.79	1.69	1.69	1.69	1.69	na	1.65	1.90	1.99	3.03	1.69	1.75	5.64	2.18
iglo	2.59	2.29	2.29	2.29	2.19	2.69	na	na	na	2.69	2.99	2.69	na	2.52
ferrero	2.69	2.65	2.65	2.65	1.89	2.65	2.45	3.29	2.79	3.90	2.55	2.65	3.29	2.78
penaten	2.65	2.35	na	2.29	2.35	2.99	2.33	3.77	2.89	4.17	2.89	2.99	3.14	2.90
trumpf	2.99	2.79	2.37	na	2.59	na	2.69	3.49	3.29	3.72	2.49	2.99	3.80	3.02
krueger	3.29	2.99	3.29	3.29	3.29	3.29	2.89	3.79	3.49	4.19	2.89	2.22	4.29	3.32
perfectfit	2.99	3.45	na	na	2.79	4.25	3.79	3.99	3.79	6.32	3.79	4.25	3.99	3.95
jacobs	5.99	5.99	na	4.29	4.49	5.99	6.59	7.89	6.59	5.49	5.99	3.99	6.42	5.81
gorbatschow	8.49	8.49	7.49	7.49	7.49	7.99	8.99	8.50	8.99	8.49	8.99	7.99	8.95	8.33
jdaniels	na	17.99	na	na	18.59	na	19.99	18.20	18.49	21.29	18.99	19.99	19.82	19.26
Mean	2.69	3.61	2.29	2.86	3.43	3.06	3.90	4.97	4.37	4.58	3.78	3.69	5.40	

Source: Nickolaus (2015) and own computation.

Appendix B. Price levels (Euro) and dispersion across pure online, pure offline and multichannel retailers

	Pure offline retailers			Pure online retailers			Multichannel retailers			Pure online –	Multichannel –
	Mean	Median	Disp.	Mean	Median	Disp.	Mean	Median	Disp.	Multichannel	Pure offline
bebivita	0.65	0.65	na	0.87	0.87	0.20	0.68	0.65	0.07	0.19	0.03
droetker	0.65	0.65	na	0.89	0.79	0.29	0.77	0.79	0.09	0.12	0.12
rittersport	0.99	0.99	0.00	1.03	1.00	0.15	0.98	0.99	0.03	0.05	-0.01
kraft	1.64	1.64	0.22	1.78	1.78	0.31	1.31	1.39	0.14	0.48	-0.34
leibniz	1.69	1.69	0.00	1.82	1.64	0.25	1.74	1.79	0.06	0.07	0.05
ricola	1.75	1.75	na	2.28	2.27	0.18	1.91	1.89	0.04	0.37	0.16
unclebens	1.69	1.69	0.00	3.06	2.47	0.60	1.77	1.72	0.06	1.29	0.08
iglo	2.29	2.29	0.00	2.69	2.69	na	2.57	2.64	0.10	0.12	0.28
ferrero	2.65	2.65	0.00	3.23	3.29	0.18	2.55	2.65	0.10	0.68	-0.10
penaten	2.32	2.32	0.02	3.35	3.46	0.24	2.79	2.89	0.08	0.56	0.47
trumpf	2.79	2.79	na	3.43	3.61	0.15	2.79	2.79	0.11	0.64	0.00
krueger	3.14	3.14	0.07	3.79	3.99	0.17	3.11	3.29	0.12	0.68	-0.03
perfectfit	3.45	3.45	na	4.52	3.99	0.27	3.64	3.79	0.14	0.88	0.19
jacobs	5.14	5.14	0.23	6.60	6.51	0.15	5.51	5.99	0.16	1.09	0.37
gorbatschow	7.99	7.99	0.09	8.73	8.72	0.03	8.20	7.99	0.07	0.53	0.21
jdaniels	17.99	17.99	na	19.83	19.91	0.06	19.02	18.79	0.03	0.81	1.03

Notes: Dispersion (Disp.) is defined as the coefficient of variation. The last two columns report the differences of mean prices between pure online and multichannel retailers and multichannel and pure offline retailers respectively.
Source: Own computation.