

EFFICIENCY COMPARISON OF ONLINE AND OFFLINE MARKETS: EVIDENCE FROM THE TWO LARGEST U.S. RETAILERS

Master Thesis

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Table of contents:

1. Introduction	4
2. Literature Review.....	6
3. The new Online-Market.....	9
a. The Key Trends.....	9
b. GAFAE.....	11
4. Market Efficiency	12
a. Price Level	12
b. Price Dispersion.....	13
c. Price Elasticity	13
d. Menu Cost.....	14
5. The Data Set.....	14
a. Data Collection	15
b. Electronic Product Category.....	15
6. Data Evaluation.....	16
a. Comparison Within the Retailer	17
i. Walmart	17
ii. Price Level	18
iii. Price Dispersion.....	19
b. Comparison Between Retailers	21
i. Amazon.....	21
ii. Price Level	22
iii. Price Dispersion.....	23
c. Discussion	25
7. Conclusion	26
8. References.....	28

Abstract

The online market has developed into an equally strong competitor to the offline market. This study examines the market efficiency of the U.S. online and offline market based on the price level, price dispersion, price elasticity and menu cost. A direct comparison of all four market efficiency criteria based on empirical results is not discussed in the literature. Here, the empirical study analyzes and compares the online and offline prices of electronic products between the two largest retailers, Amazon and Walmart. The results clearly indicate that the online market is more efficient than the offline market. Comparing the online prices between the multichannel retailer Walmart and the pure online retailer Amazon we find that for 64.5% of the electronic products, Amazon has the better offer. While 26% of the prices are identical and only 9.5% of the overall prices offered by Walmart are lower. The price advantage of Amazon is explained by the strong price linkage between the online shop and the less efficient offline shop within the retailer Walmart. In 73% of the examined prices, the online and offline prices at Walmart are identical. Furthermore, this price linkage causes a high price dispersion of 14.7% between the online shops of the two retailers. As soon as Walmart breaks the price linkage through sales offers in their online shop, the price dispersion between the two retailers drops to 10.2%.

1. Introduction

The Internet network is used by 4 billion people worldwide. In the year 2018, 78% of these users conducted product research online and 1.8 billion users ended up purchasing one or more products in the online B2C market (Global Digital Report, 2018). The continuing rapid increase in internet usage in terms of user numbers and user intensity leads to a big jump in sales in the online market. Projections show a possible growth in total sales of up to 4.8 trillion U.S. dollars by the year 2021. The increase in the total sales amount is closely associated with the rise in mobile device ownership. Studies have shown that 40% of all smartphone owners compare online prices while they are in-store, shopping for a product (Clement, 2019a).

A new kind of shopping behavior has been developed in the network through an increase in mobile internet, chat applications and social media platforms. With more than 2.8 billion social media accounts, social networking is developing a great dynamic of information exchange (Theverege, 2017). Retailers target this dispersed audience with product placements on social media platforms such as Facebook (2 billion monthly active users), YouTube (1.6 billion monthly active users) or Instagram (600 million monthly active users) (Global Digital Report, 2018). Retailers use new advertisement opportunities and incorporate bloggers and celebrities as living billboards. Usually an individual with a thousand followers on social media platforms is enough to get noticed by marketing departments (Shareef, 2019). Large online retailers such as Amazon and Walmart use this kind of product placement for advertising their products, particularly to younger generations.

In the U.S. online sector, two companies, Amazon and Walmart, have a combined market share of 67% in net sales out of the top ten retailers. Competitors such as Target with a market share of 4.5% are some distance behind (Montasell, 2019). However, Amazon tends to account for the vast majority of the market share while that of traditional companies is significantly diminishing. Amazon owns nearly 6% of the overall U.S. B2C market share by only performing partially in the offline market. In comparison, Walmart owns 8% of the market share in the same market but with a total of 4,769 offline stores throughout the United States as of 2019 (O'Connell, 2019). There is no evidence of considerable differences in either the sales strategy of both companies or in the products they are selling. The only recognized difference lies in the retail channels of the companies. While the multichannel retailer Walmart performs in both the online and offline market, the pure online retailer Amazon focuses mainly in the online market.

Since the Internet has developed into a channel for electronic commerce (e-commerce), some previous research assumes that the Internet is an efficient market (Bako, 1997). Efficient markets immediately and entirely reflect all information that is relevant for the price or price formation (Grossman, 1980; Gordon, 1985). In retail markets where sellers set prices, efficiency occurs when prices are equal to the retailer's marginal cost. If the efficiency of a market increases, the prices closely approximates the marginal costs. The main advantages of the online market are the low search costs and increased market transparency. According to the latest market reports, the e-commerce is overtaking the traditional offline market (Rooney, 2019). Furthermore, every online shop on the Internet is just a click away. Geographical distance is no longer relevant and information is accessible at all times (Riggins, 1999). These characteristics of the online market explain the high net sales of online retailers compared to the competition. Therefore, the following sections discuss the actual differences in market efficiency between the online and offline market.

Brynjolfsson and Smith (1999) measure the efficiency of online markets in four dimensions: price level, price dispersion, price elasticity and menu cost. Here, these four efficiency criteria form the base for the empirical comparison between the offline and online market. This study has access to a dataset that contains prices for electronic products of Walmart and Amazon in the U.S. online and offline market collected in the years 2015-2016. The data set allows for the analysis of price level and price dispersion within the retailer Walmart, as well as between the two retailers. In addition, it allows for conclusions about the menu cost and the price elasticity for both markets.

This study tests for market efficiency by comparing the two largest retailers in the U.S., as well as comparing the prices of the most competitive product category in the online market. Electronic products are the most profitable product category in terms of sales for the top ten online retailers worldwide (Clement, 2019a). This competition ensures that possible market failure such as arbitrage opportunities, information failure or high mark-ups do not influence the empirical results. The relatively low transportation cost for electronic products reduces the possibility of geographical price discrimination and benefits the law of one price. Therefore, differences in the price level or price dispersion account to the differences between the efficiency of online and offline markets.

Based on empirical results, this study discusses the market efficiency of the online and offline market with perfect competition. The results indicate that the online market is more efficient in

terms of a lower price level, higher price elasticity and lower menu cost. However, the test for price dispersion provides mixed results but shows that an increase in the market competition is followed by a decrease in price dispersion. Section 2 gives a literature review on the four efficiency criteria price level, price dispersion, price elasticity and menu cost with the main focus on the online market. Section 3 sums up the latest developments in the new online market. Section 4 explains the connection between the four criteria and market efficiency. The source and collection of the data are discussed in Section 5. The evaluation and discussion of the data are shown in Section 6. Section 7 gives a conclusion and delves into the future development of the online market.

2. Literature Review

The first judgment about the online market mostly refers to the low price level relative to the offline market. The literature confirms the hypothesis that on average shopping in the online market is cheaper compared to buying in the offline market. The empirical results regarding the price level in the early 2000s show that prices on the Internet are lower than in traditional shops. Brynjolfsson and Smith (1999) studied the trading of books and CDs in the United States for 15 months in 1999. After a direct comparison of prices in traditional and online shops, they conclude that the average prices online were around 15% lower than in physical stores. The online shops offer 84% of the CDs and 90% of the books for a lower price. Tang and Xing (2001) use DVDs to examine pure online retailers and multichannel retailers. They conclude that pure online shops sell their products by about 14% cheaper than hybrid stores. The work of Pan, Shankar and Ratchford (2002) compares pure online retailers with multichannel retailers. In addition to the price, they also relate to influencing factors such as Website presence, seriousness or information preparation. The result shows that the prices in pure online shops are significantly lower than in shops with multiple sales channels.

More recent comparisons of offline and online prices expanded on the product categories covered but were limited to small datasets from a few stores (Borraz et al., 2015). However, with the further development of the Internet and new data possibilities, Cavallo (2017) compares online and offline prices within multichannel retailers worldwide and shows that 72% of the prices for all pooled observations in the online and offline market are identical. Offline and online prices have adapted to each other within multichannel retailers. While in Japan only 50% of the prices match, in the countries Canada or the UK over 90% of the prices are identical. In the USA the percentage of equal prices is at 69% and close to the overall average. However,

Cavallo also agrees with the results from the early 2000s and confirms that if there are price differences between the online and offline market, the online prices are usually lower. Wang (2019) links the pricing power of online retailers to the online sales channels, transaction security and commodity features. Furthermore, online retailers usually differentiate from offline retailers in terms of commodities, market positioning and service characteristics to meet the diversified demands of customers.

The second improvement regarding the efficiency of online markets refers to the reduction in price dispersion. The reason for this assumption is the low search cost that makes price dispersion between companies recognizable. However, Clay (2001) finds that online sellers with the largest market share often do not have the lowest price. The given reason is that uninformed customers only know a limited number of sellers. Since they do not want to incur any search costs, they buy from a known online seller and accept a higher selling price (Brynjolfsson, 1999). The name recognition of some retailers can also explain why online retailers that are active in the offline market as well can charge a higher price. They are mostly better known for their traditional shops. Customers have already gained experience through the traditional shops and are therefore more likely to make online purchases at the same retailer, even at a higher price. Baye et al. (2006) continue that the prices of retailers who are offline and online, hardly ever represent any price dispersion in their products. The lack of price dispersion within multichannel retailers leads to the realization that the price dispersion in the online markets is not necessarily smaller than the price dispersion in offline markets. The online market at least entices companies to have little or no price dispersion in the company's internal prices. One reason for price equality within companies is the fear of angering customers. Customers who purchase a product in the offline market and later find the product more cheaply on the company's online platform suddenly combine the shopping with a negative experience. In the worst case, the company loses these customers to the competition. Carvallo (2014) explains that this fear of a possible loss of customers leads global players such as Apple or Ikea to avoid price dispersion between countries in which it is unusual for customers to compare prices with neighboring countries.

Despite the results of Carvallo (2014), economists point out that price dispersion in the offline market might be underestimated and is higher compared to the online market. Kaplan and Menzio (2015) recognize higher price dispersion in the offline market as soon as they compare between retailer prices instead of within retailer prices. However, the period of data collection must also be taken into account here. Collecting offline prices for more than one week can cause

measurement errors when comparing the price of a product on Monday with the price of the same product on Friday. As a result, the prices can differ although they were on the same level over the entire period.

The price elasticity is strongly related to the price level and price dispersion. With the introduction of shopbots, which make the comparison of prices of commodities more efficient, the relation of price elasticity, price level and price dispersion becomes clear. Perloff and Salop (1985) state that an increase in price elasticity leads to a lower average price level. If a market is experiencing perfect elasticity, the price decreases towards the competitive level. Pratt et al. (1979) continue that a lower average price level leads to lower price dispersion (Clay et al., 2001). Economists have adopted the notion of demand elasticity as a driving source of price dispersion (Walsh and Whelan 1999). Furthermore, an increase in the price elasticity of demand leads to a decrease in the average mark-ups (Barron et al., 2004). The result is a reduction in price dispersion as the increase in price elasticity of demand lowers prices of all retailers toward their marginal costs.

Nevertheless, some empirical studies analyze the price elasticity as a distinct area. Deregatu, Rangaswamy and Wu (2000) examined price sensitivity in offline and online retailing. They conclude that customers who shop online show a higher price-sensitivity. Ariely and Lynch (2000) find similar results. They simulate the retail of two online shops selling wine. With a decreasing search cost for a product that is available in both online shops, the price sensitivity of the customers increased. They also notice that price sensitivity decreases with increasing product information. A more recent study finds that price elasticity on the flight ticket market is higher online than offline. Again the price pressure decreases as product information becomes more specific (Granados, 2012). Thus, the price elasticity that increases due to the low search costs on the Internet can decrease with additional product information.

The literature confirms the assumption that menu costs in online markets are low and lead to more frequent price changes. Bailey (1998) examined the menu cost by counting the number of price changes. Since price changes occur more frequently in the online market, he concludes that the costs of changing prices are lower in the online market. Brynjolfsson (1999) shows in his study that there are more frequent and smaller price changes in online shops than in traditional stores. The smallest price changes in the online market were one hundredth of the smallest price changes in the traditional market. On the one hand, this development leads to an increased possibility of negotiation between buyers and sellers. On the other hand, well-

informed sellers can charge different prices and implement price discrimination. Although this increases the profit of the companies, especially the customers who appear to be weak in bargaining power ultimately pay a higher price than customers with high bargaining power (Cortese 1998).

Furthermore, with developing online shopping possibilities, the change rate of the online prices also increases. While Nakamura and Steinsson (2008) recorded an implied duration for price changes of approximately 7.6 months, ten years later, the frequency of online price changes halved to 3.5 months in the study by Gorodnichenko (2018). Both studies work with prices from similar product groups. One reason for this increase is not only the lower menu cost but also the algorithms developed by companies. These can change the prices of a wide variety of products every minute. Algorithms called dynamic pricing are particularly popular in the flight ticket industry, on eBay and Amazon marketplace. In addition to dynamic pricing, which analyses customers' purchasing habits, of course, algorithms can also analyze the price setting of the competition more efficiently. On this basis, a price change from a large retailer can affect the price of the whole industry if competing companies give in to price pressure and adjust their prices in order to remain competitive (Gorodnichenko, 2018).

3. The New Online-Market

The e-commerce accounts for over 10% of total retail sales worldwide and is likely to rise to 40% by 2025 in the non-food market (eMarketer, 2016). These numbers are predicting that online retailing will quickly take away even more sales from traditional retailers over the next few years. Many - especially small retailers will probably have to close their shops or reinvent themselves as quickly as possible. One option is to transform into a multichannel retailer that is active in both the online and offline market. The next section discusses the most important market trends that need to be considered when entering e-commerce.

a. The Key Trends

The online boom is only at the beginning. Just a third of the retailers and not even 2% of the manufacturing companies or wholesalers in European countries also sell directly online (Zimmermann, 2017). Considering that real mobile commerce and tablets are just over six years old, the question remains, which aspects will have a lasting impact on online commerce in the future.

The biggest threat to the suppression of traditional retail is the rise in mobile Internet usage.

90% of the social network users are entering the social network with a mobile device (Global Digital Report, 2018). As a result, generation Y and Z are leading the most influencing trends in the online market. Smart natives or millennials will increasingly affect the retail market.

They consider the smartphone as an essential device of everyday life. A vital shopping channel and influence are social platforms in which influencers, friends or family can tempt the millennials to spontaneous purchases (Accenture, 2017). The Accenture study (2017) shows that 69% of 18 to 30 year-olds like to shop directly through Snapchat, Instagram & Co. Social media platforms inspired about 44% and curated shopping about 73% of this age group to purchase new products. Dealers should focus on building new customer loyalty through social media.

Furthermore, inventions such as the curated shopping make mobile purchasing even more popular, especially in the individualized product consulting. The connection of the web with the camera function of a mobile device brings innovative applications that use augmented reality or virtual reality. Professional shopping curators carefully choose a limited number of products for the different dispersed customer groups. Curated shopping is becoming more popular among online consumers (Cha, 2018).

In order to make a profit in online trading, it is vital to recognize and use the so-called "firstmover" advantages. A first-mover can either develop a new business idea or can act as a Copycat. Copycats, imitated business models from successful U.S. pioneers, such as Zalando copied Zappo's and are typical followers. However, they can be "first movers" in unoccupied markets (Forbes, 2014). Zappo's was not active in the European market at all. Zalando realized this as an opportunity and simply copied the business idea to implement it in the European market. The foreign markets occupied by the Copycat should no longer be significant for the actual first mover.

Also noteworthy is the trend of cross devices and mixed conversions. Currently, more than two devices are involved in one-third of all online transactions (Criteo, 2016). The country China shows that 32% of purchases made on smartphones start on the desktop. The shopping experience needs to have a seamless user experience across all devices. Compared to classic television advertising, which reaches a broad audience of viewers across channels, potential customers now spread out to multiple media devices. Accordingly, the trend of micro-range advertisement is getting more attention from marketing departments. Advertisements can be

placed anywhere on the Internet. A company can attract any target group surfing on the Internet with an advertisement for that specific group (Shareef, 2019).

In order to maximize the presence in the purchasing process of a consumer, pure online players must also focus on the traditional market. However, offline branches require additional capital for the construction of complex branch systems. As a solution, the trend is already going towards intelligent offline partnerships. Pure online players such as Warby Parker cooperate with bricks and mortar opticians who offer all stationery services as well as their collection on-site for the online retailer. Above all, online retailers with consulting and service-oriented ranges are increasingly making use of the option of intelligent offline partnerships. The multichannel concept also comes into play in order to reach out to the customer in whichever area he moves, be it online or offline (LS retailers, 2017).

b. GAFAE

Resistance in the middle class opposes the development of the GAFAE companies (Google, Apple, Facebook, Amazon, eBay). The big five are still spreading out, absorbing more and more business models and are on their way to becoming Internet oligarchs. In the western hemisphere, Amazon dominates the e-commerce world with approximately 178 billion U.S. dollars in net revenue in the year 2017 and an increase to 232.88 billion U.S. dollars in the year 2018. To overtake Amazon, seems to be impossible by now (Global Digital Report, 2018).

Besides, there are problems that the chasers have to establish themselves in the online market. In the case of traditional shops 5-10% of a decline in sales is often enough to make the shop shut down. For an online retailer a shutdown is already the case if there is no growth at all. While Amazon is satisfied with a minimal margin of less than one percent, other online shops are fighting for every breath of air on the market in order to survive. The fierce competition is forcing them to rely on continuous growth as a survival strategy. However, costly investments are yet to be earned or tiled back in the next few years. Investments in the future are unavoidable because online retailers are under extreme pressure to innovate. Only as an innovation leader, a company can stay permanently at the top. Not every online shop and young entrepreneur can endure this in the long run. If products, service, delivery times, payment options and even the look of the website are interchangeable, the only difference is the assortment variety and the price. However, only the big and aggressive market participants can win this competition. Market niches provide better chances to stay in the market. Thus, a highly specialized shop can

still generate considerable returns regardless of price pressure. The maxim is ultra-specialization - but with reasonable growth prospects (Haucap, 2014).

The motto for the European market is now to learn from the US group. First, GAFAE does everything to gather customer data and create motion profiles. Second, customer loyalty is cheaper than customer acquisition. Amazon Prime leads by example. Google and Facebook are also trying to find out what the users like, just to offer it to them afterward.

The development of the online market and the outlook for the future are reason enough to observe and analyze the online market more closely. As described, an outlook into the future shows that the more modern online market is replacing the traditional brick-and-mortar retail, since the online market is considered more efficient. In contrast to traditional markets, online markets offer some unique features. Geographic distances are becoming less relevant, every online shop on the Internet is just a click away and information is cheap and available at all times. These advantages reduce the search costs for buyers. Processing and delivery times for a product are generally shorter and services can be automated more easily (Riggins, 1999).

4. Market Efficiency

Four efficiency criteria serve as the basis for the empirical comparison of the offline and online markets. The following four efficiency criteria are listed and explained in this section:

Price level, price dispersion, price elasticity and menu cost.

a. Price Level

In an efficient and perfectly competitive market the price level corresponds to the marginal costs. Brynjolfsson and Smith (1999) assume that online markets are more efficient than traditional markets in terms of price levels. The main reason for this is the lower search costs. Lower search costs arise in online markets for both the buyer and the seller.

On the one hand, the buyer can find out more about the product and price and compare them. The low search cost increases the transparency of the market for the customer and makes it easier to find providers with lower prices. The increased price pressure on the providers can potentially lower the price levels.

On the other hand, the retailer can advertise its products more efficiently to many customers via the online market (Bako, 1997; Bako, 1998) and thus reach more potential customers.

Overall, the operating costs in online shops are lower than those in traditional shops, which can lead to lower prices in the long term (Brynjolfsson 1999; Smith 1999). Besides, lower entry costs lead to a higher number of market entries and thus greater competition, which also leads to lower prices on average.

The entrance in the online market from Barnes and Noble's in March 1997, describes best the effect that the online market can have on the price level. During the three months following the market entrance, Amazon.com dropped its prices by nearly 10% to compete with the prices charged by Barnes and Noble's (Bailey, 1998).

b. Price Dispersion

High search costs, asymmetrically informed customers and product heterogeneity are the main reasons for high price dispersion. Since the search costs in online markets are low and information is distributed more evenly among buyers, less price dispersion can lead to a more efficient online market (Smith 1999).

Fully informed and rational customers buy from the provider with the lowest price. However, if some customers are not fully informed, they are divided among the retailers according to different standards. In the online market, where a higher number of informed customers are assumed, this would lead to the majority of customers (all informed customers and some of the uninformed customers) getting their goods from the cheapest retailer (Brynjolfsson, 1999).

However, product or seller heterogeneity can continue to cause price dispersion. Product heterogeneity does not only refer to the product itself but also the related services (Brynjolfsson, 1999). Even for products that appear homogeneous at first glance, the retailer can include additional services. Typical examples are return rights or tools to support decisions on the web pages.

c. Price Elasticity

Price elasticity indicates how strongly the demand for a product reacts to price changes. A relative change in demand is compared with a relative change in the price of a particular product. Price elasticity can be used as a measurement to determine whether price changes are an appropriate sales policy tool. Thus one speaks of an elastic demand if the price elasticity is greater than one, of a rigid demand if the price elasticity is equal to one, and of an inelastic demand if the price elasticity is less than one.

An efficient market consists of very price sensitive costumers, available commodities and a high level of information supply. An increase in the price elasticity can result, among other things, from lower search costs (Brynjolfsson, 1999). Furthermore, price elasticity has a significant connection with price level and price dispersion, especially for commodities such as electronic products. As the literature review shows, an evaluation is not necessary in this case. Because all products in our data are commodities, and both retailers are pre-screened for quality, there is very little differentiation among retailers or products. Therefore, price level and price dispersion can explain the price elasticity.

d. Menu Cost

Low costs of price changes are expected in online markets. While the price change in traditional markets is associated with new labeling and renaming of the products, in online markets a price change is usually only a matter of seconds (Smith 1999). Since price changes only occur when the benefits outweigh the costs, prices in online markets are changed more frequently and also by smaller amounts. In traditional markets small price changes rarely occur due to the high menu costs (Gorodnichenko, 2018). Therefore, low menu costs can avoid price stickiness, which makes the market more efficient.

Due to the constant development of the online market, the time and cost range of a price change are close to zero. One reason is a reduction in physical work in order to change price tags. Also, companies can react faster to changes in the market due to low information costs and search costs. Ultimately, the costs of communicating a price change to potential customers through advertising measures also decrease. The reduction of costs and time investment stimulates negotiations between retailers and consumers. Those attributes lead to a more efficient market where product prices will be closer to the actual marginal costs (Narahari, 2005).

5. The Data Set

The data for the empirical evaluation stems from the Billion Prices Project at MIT (BPP). The data set only includes companies that are in the top 20 in terms of their country's market share and sell their products online and offline (Euromonitor International's Passport Retailing Global Rankings, 2014). Multichannel companies that sell their products offline and online are continuously carrying the largest share of all retail transactions.

a. Data Collection

323 employees collected offline prices in bricks and mortar shops of 56 companies in 10 countries. Each employee collected a scan of the barcode, manually documented the price and took a photo of 10-50 products in any physical store of a given retailer. This data is cleaned, processed and saved in an app. The application of the app minimizes the likelihood of incorrect price information and makes the data collection of offline prices faster and more accurate.

The scanned barcode is used to obtain the online price of the individual retailer within seven days, using online “scraping” software. The ID number that can be determined by the offline barcode leads to the same product in the online shop. If there is no match, online and offline prices cannot be compared. Within most large retailers, the identification of the product by the ID number is possible in the online and offline market.

The documented price displayed by the retailer's website is the current price of the product. Discounted online products are still compared directly with the offline price. While the sale offers on the offline and online market can differ, a different taxation of the two markets is not possible. The direct comparison of online and offline prices accordingly takes into account taxation and discount offers. However, the shipping costs of the products are left out. This measure is justified by the many means of transportation that cause different costs and also develop rapidly.

With this method, the employees documented 38 thousand price comparisons in the matched online-offline data set from December 2014 to March 2016. A total of 24 thousand products were collected and evaluated. The data set shows that the online prices of a company are identical between different IP addresses in the online market. Therefore, the collection of online prices from one IP address for each country is not a problem.

b. Electronic Product Category

The following data evaluation only focuses on the category of electronic goods. The examined data set consists of 233 electronic products sold in the online and offline shop of Walmart. The variety of the products reaches from laptops, printers and TVs to headphones, hard drives and computer mice. Furthermore, for 140 electronic products there are three or more offline prices that have been collected at different zip codes. This results in a total of 833 collected prices which can be compared between the online and offline shops of Walmart.

To compare the prices between the online shops of Walmart and Amazon, this study examines products that differ in their prices with more than 30% in more detail. The documentation of these products is not evaluated if the product names differ in the price comparison between Walmart and Amazon. Due to different product names, 13% of the documented prices are ignored.

The evaluation of electronic products is particularly reasonable for this study for the following reasons. First, this category of goods is highly relevant for online purchases. The top ten online retailers worldwide all have their most valuable category in terms of sales in the electronic and media segment, which makes the electronics market to the most competitive market on the internet (Forbes, 2019).

Second, many studies dealing with the price comparison of online and offline markets rarely consider the high transaction costs associated with product categories such as groceries, which makes actual price comparison between retailers hard. Although relevant data for these products are easy to procure, the danger is that even high arbitrage profits from national and international trade with the products are hard to realize due to high transport costs. The electronic products analyzed here do not have this disadvantage. Electronic products such as computers, printers or game consoles are usually produced outside the United States. Therefore, transport costs to different states in the U.S. do not play a significant role in the business. Consumers can use even small arbitrage profits, which leads to a high amount of price comparison for electronic products in the North American or European markets (Gorodnichenko, 2017).

Third, electronic products are simple to compare because their product descriptions are very well defined. Customers can compare the price of a product among retailers but also on the international market (Gorodnichenko, 2017). Furthermore, electronic products have a high level of product homogeneity in additional services, which again makes it easy to compare them with other retailers.

6. Data Evaluation

This study focuses on the prices of electronic goods in online and offline shops in the U.S. A strict comparison of the market efficiency between a pure offline and a pure online retailer is not possible for a simple reason. There is no evidence of pure offline retailers that trade electronic products. This market belongs exclusively to multichannel and pure online retailers. Therefore, Section 6.a. compares the market efficiency between the online and offline shops of the multichannel retailer Walmart. Following, Section 6.b. investigates the market efficiency

between the multichannel retailer Walmart and the pure online retailer Amazon. In particular, the differences in price level and price dispersion are pointed out. The efficiency criteria for both markets defined in Brynjolfsson and Smith (1999) are tested in the following two hypotheses:

Hypothesis (1): The average price level of articles in the online shop is lower than the average price level of the same articles in an offline shop.

Hypothesis (2): An increasing market competition from online retailers on the distribution of a product decreases the price dispersion of the product.

a. Comparison Within the Retailer

The data set analyzed in this section consist of electronic products that are sold by Walmart in the USA during 2015-2016.

i. Walmart

Walmart is the largest retailer in the world in terms of market share. The revenue of Walmart in the United States in 2013 was 274 billion US Dollars and grew up to 332 billion US Dollars in 2019. With 11,766 stores throughout the world and 4,769 stores throughout the United States as of 2019, Walmart is very present in the offline market. In terms of revenue, Walmart U.S. is the most profitable segment of Walmart's three business segments. Walmart U.S. also includes the e-commerce website, www.walmart.com that operates in the company's domestic market of the United States (Statista.com, 2019). With online revenue of 14 bn. USD walmart.com is the second-largest e-commerce retailer in the United States.

In terms of market efficiency, Walmart shows that they compete with the best. Especially in the offline market, many companies should take Walmart as a role model for cost-efficient retailing. The following reason secure that Walmart can offer the lowest prices in the offline market and leave other multichannel retailers behind them. First of all, the philosophy of Walmart is to keep the operation cost low by keeping the design of the offline shops basic and by operating with a largely automated supply-chain management system. Besides, executives use prescribed and limited budget travel options and until recently, Walmart paid employees less than other competitors (John, 2019). Second, Walmart is the only big retailer in many areas of the USA. About 90% of Americans have access to a Walmart shop within a distance of 24km. Furthermore, the variety of products offered in the offline stores of Walmart can satisfy all household needs. The company can count on millions of customers using its physical stores as

their first go-to spot. Taking that into account, Walmart can increase its profits by the sheer volume of products they are selling even if their margins are small. Walmart has vast bargaining power when it comes to its suppliers. Many brands depend on Walmart sales to stay in business, while even larger, established companies can little afford to be removed from Walmart's aisles or webpages. Third, Walmart is directly sourcing from the manufacturers that make the products it sells and the farms that produce food for its grocery sections, and it increasingly sends its trucks and drivers (Hyde, 2019).

Overall in the online market, consumers show high demand in electronic products, relatively low transaction costs and low search costs, which all benefit the law of one price and leads to high international market competition. The strongest category in terms of sales on the website of Walmart is the segment of electronic and media products (Forbes, 2019). Besides, with its high market share and the efficient offline sales strategy, Walmart is reflecting the prices of electronic devices on the US online and offline market very well. The evaluation of electronic products that are traded by Walmart to analyze the price settings between the online and offline market in the USA is accordingly sufficient and meaningful. Furthermore, the results can show parallel to European or Canadian markets.

ii. Price Level

In order to investigate Hypothesis (1), the observed prices are examined statistically for significant differences.

Comparing the prices of the retailer Walmart in the online and offline market, there is no price difference for 73% of the prices. Table 1 provides an overview of the differences in the price level of the three segments All Products, products with an online discount and the products with a regular price in the online shop. The columns show the share of identical prices (1), the share of the prices that are higher online (2) or lower online (3) and the overall difference in the price level (4) for each segment.

TABLE 1: PRICE LEVEL WITHIN THE RETAILER

	(1) Identical (%)	(2) Higher Price Online (%)	(3) Lower Price Online (%)	(4) Price Difference to Offline Shop (%)	(5) Observed Prices
All Products	73	5.4	21.6	-2.6	833
On Sale in Online Shop	45.6	5.5	48.8	-17.1	360
Regular Price in Online Shop	95.3	4.6	0.1	1.0	473

A consumer can find 21.6% of the electronic products traded by Walmart cheaper in the online shop, while 5.4% of the products are more expensive online. If there is a price difference (27% of the prices) between the online and offline offers of the Walmart US Group, 81.4% of the prices are cheaper online. All products that cost less online (21.6% of all products) appear to be on sale online. A total of 43.2% of the online prices are on sale. The consumer obtains an actual price advantage of more than 10% compared to the offline shop for 28% of the online offers. Moreover, only 4.7% of the prices that are not on sale differ from offline prices, while 4.6% of those prices are higher online.

Only the products that are on sale online are cheaper to buy online. 28% of the offers guarantee an actual price advantage of 10% or more. This finding suggests that the menu costs in the online market are lower than in the offline market. Despite a discount offer, 45.6% of all online offers still have the same price as in an offline shop. The low menu costs entice to advertise products that have no or only a minimal discount in order to persuade consumers to buy a product through an alleged offer. It is easier and cheaper to advertise products with a discount in the online market.

If a consumer does all of his shopping for electronic products in the online market, he saves an average of 2.6% compared to buying the same products in the offline market from the same retailer. If a consumer only concentrates on the products that are on sale in the online shop, he can save an average of 17.1% by comparing prices with the offline shop.

iii. Price Dispersion

In order to investigate hypothesis 2, the price dispersion within offline and online shops must be compared. Only products for which we have more than two prices from different located offline shops are evaluated. There are three or more prices for 140 electronic products that have

been collected at different zip codes. In total, 85.2% of the prices from the common dataset are evaluated in this section. The price dispersion for electronic products sold on the Walmart US website is zero. Of course, this can be explained by the fact that the same website is available throughout the USA. No zip code is required to enter the website.

The price dispersion between the offline branches of the retailer Walmart is more interesting to observe. The persistent approach to test for price dispersion for commodities in the literature is to analyze the standard deviation. Here, no price dispersion is found for any electronic product. The standard deviation of the prices between the offline markets is 0%. At second glance, this result is less surprising than expected and agrees with empirical surveys by other economists (Cavallo, 2016). Cavallo (2016) examines the price dispersion within retailers of electronic products and results that 96% of the prices within a retailer for the product category are identical. Cavallo (2016) works with the prices from a total of 9 retailers, only one of which shows a price dispersion between the company's offline shops. However, the price dispersion in the offline market is only extremely low for electronic products. The non-existent price dispersion is due to the low transport costs of electronic products relative to the high product price. The price dispersion of food or drugstore items is much higher. In the grocery sector, this is due to high transport costs. Despite the low transport costs of other product groups, consumers also refrain from shipping products that already have a low purchase price relative to the transport cost.

Another explanation for the lack of price dispersion within multichannel retailers is the low information costs for consumers. The effort to compare prices not only between the online and offline market but also directly between offline shops has decreased significantly. Companies such as Walmart cannot afford to offer products at different prices and give customers arbitrage opportunities through low transportation costs.

Furthermore, the offline prices of a product in different offline shops were always registered on the same day. Deviations from the presented results can arise from comparing prices of a product that are documented over a week. These measurement errors could cause price dispersion if the product price changes during the week, but the one price got registered on a Monday and another price for the same product on a Friday.

Another reason for the higher price dispersion of a product in other studies is the price comparison between retailers. Products can differ in the price between retailers if additional services such as warranty or maintenance costs are no longer homogeneous among retailers.

The prices in the examined data set are free of additional service differences as well as special promotions such as coupons that change the actual price when paying. The registered price in our data set is the one that is accessible to everyone. This study documents no price dispersion because measurement errors in the data set, market failures, a lack of market competition or heterogeneous products do not influence the result.

With regards to Hypothesis (2), we can conclude that within Walmart a higher distribution in sales of a product category through the online shops decreases the price dispersion of that product category in the offline shops.

b. Comparison Between Retailers

A judgment of the actual market efficiency is limited when only analyzing the prices within retailers. Multichannel retailers tend to set identical prices in their online and offline shops in order to achieve a uniform public image. Such a price linkage is not the case for pure online retailers like Amazon. This part analyses the prices between the online shops of Walmart and Amazon in the U.S.

i. Amazon

Within the top ten online retailers in the U.S., Amazon has a market share in sales of 54%. Second but further behind lies Walmart.com with a market share of 13% (Montasell, 2019). Choosing those two retailers secures a comparison of the most competitive companies in the online market. Furthermore, the comparison shows the different market behaviors of a multichannel retailer and a pure online retailer.

Once again, the prices of electronic products are analyzed. 44% of Amazon customers have bought at least one electronic product. Walmart.com as well as Amazon have the most sales in this category. Electronics and Media is the market with the highest competition on the Internet. Also, electronic products have a very high degree of homogeneity between retailers (Forbes, 2019). Section 5.b. lists further reasons for choosing the described product group.

Discussing the market efficiency of online shops, an inclusion of the retailer Amazon is unavoidable. Amazon accounts for a market share of online sales in electronic products of 86% in the United States, by domain. However, Walmart.com is only in second place with a market share of 7%. The competitors BestBuy (4%), NewEgg (2%) and Costco (1%) are even further behind (Clement, 2019b). The purchase of electronic products is often related to a large number

of price comparisons by consumers. The first platform to be accessed for research is Amazon for 66% of their customers (Clement, 2019c).

The biggest difference between Amazon compared to multichannel retailers is the independence of offline shops. On the one hand, this leads to a reduction in employees as well as in land and building expenses. On the other hand, Amazon is free of price and product linkage between online and offline shops. While multichannel retailers pay attention to present a unified image to the public in both markets, regarding the offered products and prices, Amazon focuses on the online market only. Therefore, Amazon can create a vast marketplace where third-party vendors sell products and make them available to Amazon customers. Many customers do not even know that half of all products purchased on Amazon.com come from third parties and are simply delivered by Amazon. According to the management, the Fulfilled by Amazon (FBA) program is one of the three main business channels of Amazon (the other two are Amazon Web Services and Amazon Prime). FBA allows retailers to ship their goods to Amazon's warehouse, and Amazon takes care of the shipping to customers. In return, Amazon collects a margin. The program was the main driver of Amazon's warehouse expansion (Sonsev, 2017).

Walmart.com and Amazon do not require a zip code to enter the website. Accordingly, price comparisons in different geographical locations of the U.S. are not necessary. However, the price documentation for the same product between the retailers can differ in time by up to 7 days. There are several Amazon prices for one product, which differ in the date of documentation. In order to avoid price differences due to disruptive temporal factors, the prices that are closest to each other in their documentation day are evaluated. Each product only has one price from Walmart.com and one from Amazon.

ii. Price Level

We test the hypothesis (1) in a modified form: The selling price of articles in a pure online shop is lower than the price of the same articles in the online shop of a multichannel retailer.

Comparing the two different retailers for their price levels, an adjustment of the measurements makes sense. Identical prices are those that differ not more than 3% from each other. In that case, a consumer finds 26% of the prices to be identical in the online shops of Walmart and Amazon. With 64.5% the most products are cheaper to purchase on Amazon.

TABLE 2: PRICE LEVEL BETWEEN RETAILERS

	(1) Share (%)	(2) Price Difference Above 10%	(3) Overall Price Difference (%)	(4) On Sale at Walmart.com (%)	(5) Observed Products
Identical	26	58.5	0.0	28.9	52
Higher Price on Amazon	9.5	8.5	24.4	7.9	19
Lower Price on Amazon	64.5	33.0	18.6	63.2	129

Column (2) shows that 33% of the products are more than 10% cheaper on Amazon, while for 58.5% of the products, the price difference lies between the 10% limit. Compared to the within retailer prices of Walmart, the between retailer prices show a significant price difference. Price comparison by the consumer now makes even more sense. Column (3) shows that a better offer by Walmart results on average in a 24.4% lower price compared to Amazon. In relation, however, this does not offer an option for significant savings to the consumer, since only 9.5% of all products are cheaper to buy at the Walmart online shop. Overall (200 products), a consumer can save an average of 14.3% by comparing the prices from Walmart or Amazon. If a consumer only concentrates on the products that differ in their prices (148 products) and compares them between Walmart and Amazon, he can save an average of 19.3% with hardly any search costs.

The products that Walmart.com advertises with a discount give customers weak saving opportunities as well. Column (4) shows that 28.9% of those products have the same price in the online shop of Amazon. Despite the sale offer from Walmart, Amazon still is the cheaper provider for 63.2% of the products. The active price comparison between online retailers proves to be more economical than just searching for discounts on the Internet.

On average, the pure online player Amazon beats the multichannel competitor in the competition for the lower price of electronic products in the online market. A customer who purchases all electronic products directly from Amazon saves 6.7%.

iii. Price Dispersion

In a perfectly competitive market, the costs across the competing firms are the same and all consumers are informed. Theoretically, both of these characteristics are given in this study. For most consumers buying an electronic product is a long term investment. Especially with

products in a higher price range, we expect that most consumers at least inform themselves and compare products and prices between the two biggest retailers Walmart and Amazon. For a monopolist or a small competitive market, the general intuition is that the equilibrium price dispersion is zero. The pricing and product strategy in the online segments of the two analyzed retailers are very similar. With a high market share by domain in the U.S., we would expect a small weighted standard deviation for prices of all electronic products by Amazon and Walmart.com. However, the results from the weighted standard deviation do not fit neatly to those expectations.

Despite the competitive market and the homogeneous goods, we find a standard deviation for the price between the two retailers of 14.7%. Even in a market with a strong motivation for consumer research, homogeneous goods and a low level of search costs, there still exists persistent price dispersion. However, when comparing only the discounted products by Walmart.com with Amazon, the standard deviation decreases to 10.2%. The price dispersion decreases when Walmart is lowering the prices through special offers. This leads to the assumption that the recorded high degree of price dispersion is due to the relatively low price offers of Amazon, especially in the electronics segment. With regards to Hypothesis (2), the price dispersion decreases by 4.5% as soon as Walmart.com is competing with the low prices of Amazon, without paying attention to the offline prices within the retailer.

The results for price dispersion reflect common empirical studies. Although the online market for homogenous goods should be competitive, there may be shopping risk perceived by consumers which leads to price dispersion between Walmart.com and Amazon. Shopping risk is the consumers' perceived risk of shopping and the transaction uncertainty related to the purchasing process at different retailers. Online consumers are worried about information privacy and fraud (Nepomuceno et al., 2014; Dai et al., 2007). These worries influence pricing and the consumers' willingness to pay for a secure shopping procedure (Al-Matarneh, 2016). The influence of shopping risk is directly related to the two different types of retailers. Zhuang et al. (2018) conclude that the shopping risk at pure online retailers is rated higher by consumers compared to the shopping risk at multichannel retailers. Following, companies with online and offline presence can set their prices higher than pure online retailers. The price dispersion is due to risk premium paid by consumers who prefer the safety of the offline presence of multichannel retailers while doing their shopping online.

c. Discussion

These findings confirm that the selling prices of goods on the Internet are lower than in offline shops, which supports the hypothesis that online markets are more efficient. Compared to other studies, this empirical evaluation is based on the most competitive product category on the Internet. The prices of electronic products are easily comparable across retailers and may be expected to follow the law of one price. However, the result of the data evaluation must be viewed critically, as other factors besides efficiency may play a role. For example, the security concerns of consumers in the online market need to be compensated by a lower price.

Nevertheless, 21.6% of the prices being lower in the online market within a multichannel retailer gives a clear result and is consistent with previous empirical studies. Moreover, 64.5% of the prices of the pure online retailer are lower than the prices of the multichannel competitor in the online market. The price elasticity typically drives the difference in price levels between the two markets. Because the cost of information is low, price levels in online markets are, for the most part, lower than in offline markets. The level of development of different online market channels may also influence the price elasticity. Innovators and first movers in different online channels may have low price elasticity, leading to higher price levels at pure online retailers compared to multichannel retailers. For example, the online market for grocery products still needs to be established and therefore it shows weak competition and low price elasticity. Such poorly developed online markets can lead to higher prices in the online market than in the offline market (Huyghe, 2017).

The high difference in price levels in this study also results from the investigated product category. The electronic product market is the most developed and competitive on the Internet. Pure online retailers must offer low mark-ups in this market with high price elasticity. Furthermore, Walmart as a multichannel retailer pays attention to matching prices across channels and to a reduction of channel conflict. This price linkage might influence the prices of Walmart.com resulting in a higher price level. The use of the online market as a channel to advertise and support their offline shops leads to the same price levels across the two markets. 73% of the prices are identical in the online and offline shops of Walmart. A lower online price level is only achieved if online prices are on sale. Walmart is using the low menu cost in the online market to advertise even small price changes with a discount on their website and in order to stand out from the offline market. The online price level of multichannel retailers is

likely higher than those at pure online retailers because they have to match the higher offline price level to keep their conventional customers happy.

This study supports the hypothesis that an increase in the market competition on the distribution of a product category from online retailers leads to a decrease in price dispersion. The price dispersion within retailers has decreased significantly. No price dispersion of the identical homogeneous electronic products could be found in the data within the offline shops of Walmart. A price dispersion of 14.7% between the online shops of the two retailers initially appears to be high. However, it must be noted that Walmart and Walmart.com want to avoid differences in price levels within the retailer. Walmart.com can only break the price linkage with the higher prices of the offline shop through discount offers. Therefore, the price dispersion drops by 4.5% as soon as only the discounted online prices of the multichannel retailer are compared with the prices of the pure online player. The price pressure from Walmart.com on Amazon is increasing. Therefore, the online shop of Walmart takes a greater influence on the online market which leads to higher market competition and the price dispersion decreases.

According to Perloff and Salop (1985), it can be concluded from the results that the low search costs on the Internet lead to a lower price level and a higher price elasticity in the online market. Furthermore, an increase in the online market competition decreases the price dispersion. The high level of discount offers by Walmart.com leads to the expectation that the menu costs are lower for the online market in total.

In contrast to other authors, consideration of other costs associated with the purchase of an item (e.g. travel or shipping costs) was omitted here. The literature uses no uniform calculation rates for shipping, processing or travel costs. One study takes all costs that a buyer incurs in a traditional or online shop (taxes, transport and processing fees and travel costs) into account (Brynjolfsson, 1999). Another survey only takes additional costs for online shopping (shipping costs) into account, while expecting no further costs for the offline shops (Anacarani, 2002). Furthermore, the presented product group in this paper gives strong evidence for the law of one price, especially because of the relatively low shipping costs and the high accessibility for customers to an offline store of Walmart in their area.

7. Conclusion

The evaluation of the electronic product prices comes to the clear conclusion that the online market for this product category is more efficient than the offline market. The result is particularly plain since electronic products with low transport costs and high product

homogeneity have perfect characteristics for the online market with its low search costs. The pure online retailer Amazon can capitalize on these market attributes very well since an expensive expansion of offline branches in this product segment does not promise any advantages. The multichannel retailer Walmart, on the other hand, links the prices of its online shop to the prices in the less efficient offline shop. In e-commerce, Walmart is not competitive in the area of electronic products due to a higher price level. For fully developed online markets it is evidenced that e-commerce is more efficient.

However, the attributes of the online market as described in section three show that pure online retailers are developing into multichannel retailers. The trend 'brick and click' (a collaboration between offline and online shops) is also gaining ground at retail giants like Amazon. It turns out that Walmart benefits from the offline presence in other product categories. The online market is more efficient in the electronic products segment while other products such as food or drugstore items show higher sales in the offline market. With this in mind, Amazon closed a \$ 13.4 billion deal with Whole Food in 2015. The deal guarantees Amazon 460 offline grocery stores in the U.S., UK and Canada almost overnight. Amazon's investment in an increased offline presence is expected to pay off especially in the areas of the food and clothing industry. For these product groups, pure online retailers are limited in their sales strategies for the following reasons. Unlike books or laptops, subjective product quality plays a decisive role in the food and clothing industry, which cannot be determined over a screen. Another limitation of pure online retailers is the high transport costs relative to the actual product price. The high transport costs make offline shops operate more efficiently and cost-effectively. Amazon also understood that there are no pure online or offline consumers. Logically, consumers like to have a choice and therefore combine the best of both markets based on individual needs.

As a conclusion of this study it can be shown that the online market is more efficient than the offline market under the circumstances described. However, until the online shopping experience for product categories such as food or clothing is not at the same level as for electronic products, offline shops will continue to pay off.

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