The Effects of User Tracking and Behavioral Management on online Prices

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I.   Introduction

The media claims, that suppliers base their prices on current demand and/or the willingness of potential customers to pay. The aim of price differentiation is to siphon off different willingness-to-pay in order to increase profits compared to standard pricing (Simon & Fassnacht, 2008, p. 257). Other objectives of price differentiation are for example: optimal capacity utilization, customer loyalty and improvement of the competitive position (Simon & Fassnacht, 2008, p. 258).

However, the dynamization of prices is not a new phenomenon. Competitors have already paid attention to consumer behavior and competing products since the very beginning and adjusted their prices. Unfortunately, for a long time tracking of customers, their behavior and thus the efficiency of measures set by companies to improve their success was very limited, as a quote, attributed to Henry Ford highlights: "I know at least half of my advertising budget works I just don't know which half" (Henry Ford, quoted by Wildner & Modenbach, 2015, p. 54).

But the fact that more and more customers are shopping online opens up entirely new opportunities for companies (Thouvenin, 2016; Hwang & Kim, 2006). According to the media, Thouvenin (2016) explains, companies can analyze the consumer data trail to create accurate personality profiles. Self-learning algorithms use this data to predict and adjust the "optimum" price for each user within splits of a second depending general available information and the specific competitive situation.

This approach is already systematically established widely in the airline and general travel industry. Most passengers are aware of the fact, that he or she paid a completely different price for the ticket than their neighbour. Although the dynamic pricing technology has been applied in the airline industry for three decades now, from the consumer's point of view there is no evidence of a strong acceptance – results show, that consumers either do not know much about dynamic pricing or do not show strong acceptance (Krämer, Kalka & Ziehe, 2016). This is also accentuated by Krämer et al. (2018), who made clear that while dynamic pricing has its economic benefits it also bears the inherent risk of angering customers who feel unfairly treated since they do have insight what other customers pay for the same product.

The authors encourage companies to always have this risk in mind, when planning price optimization strategies. On the other hand, Swart (2018) lays down that customers have already become used to certain price discrimination strategies of airlines that might have been interpreted as being unfair a few years ago.

In a similar vein, Hannak et al. (2014) argue, that personalization and individualization of prices is an ubiquitous approach in the way, business is conducted online. This development does not only concern prices themselves but the overall user experience, as the authors argue based on examples like video-on-demand suppliers or online warehouses, that aim to make predictions about users' behavior, attitude and willingness-

to-pay.

Regarding the success of video-on-demand provider Netflix, Gomez-Uribe and Hunt (2016) still describe the strong implementation of Netflix's Recommender System as one of the strongest contributions to Netflix's business value. Based on long-term data collection and use, Netflix has been able to not only recommend the right movies to its members and customers, but also to design its marketing as well as series storylines based on the experience gained (Gomez-Uribe & Hunt, 2016).

This short depiction of contemporary research on the concept of price discrimination already showcases the complexity of the field itself. Not only can it be argued, that price discrimination itself utilizes different technological approaches, but also that concepts such as the personalization of the customer journey or nudging (Sunstein, 2015; Dennis, Yuan, Feng, Webb & Hsieh, 2020) can be discussed within the concept of price discrimination as well. As Hannak et al. (2014) showcase, users can also be steered to higher-priced alternatives without altering the prices themselves. However, while these approaches are acknowledged within this thesis, the focus lies on the actual variation and differentiation of prices themselves.

The underliying thesis aims to foster understanding of different ways of price differentiation and their impact. In order to do so, a social science perspective is supplemented to discuss the perception of price differentiation and to therefore provide a user perspective. Therein also lies the main contribution of the present work: the empirical results obtained from the study conducted throughout this thesis aim to benefit both online vendors themselves as their (potential) customers, who should be enabled with a clear understanding of the effects of price discrimination and thus, with strategies to optimize their own pricing experience.

Based on these assumptions taken, two main research questions are being derived. The first research question aims to connect the proposed thesis with existing research on the topic – such as the research paper by Hindermann (2018) – and to build the foundation, on which the second research question should be addressed.

RQ1. Which approaches of user behavioral steering and online price discrimination can be identified?

RQ2. How do these approaches influence the user experience and the price given?

The distinction of these two research questions clearly indicates the methodological approach necessary to develop the empirical approach towards this thesis. A supplementary third research question builds on the initial results and views them from a meta-perspective:

RQ3. Is it possible to develop an accurate model of assessment regarding the influence of individual factors of price discrimination?

II.   Research Framework

The theoretical work of this thesis is summarized within this chapter, aiming to explain the foundation of price discrimination and its practical implementation. One of the core (technical) foundations of work in this field can be found in the field of data science.

The availability of data and the predictions based on this data enable practitioners to implement various ways of price discrimination building upon their understanding of customers' willingness to pay in dependence of variables variables (Shiller, 2013). This is also highlighted by the recent work of Xu, Tang and Zhou (2020) who name the application of data science to be one of the major foundations of work in this field.

Methodological Approach and Structure

Following this short introduction in the subsequent argumentation approaches are described to answer the research questions presented above. These research questions can and will be answered from two

different perspectives: In a first step, the thesis analyses the relevant scientific literature will be analyzed and presented in order to identify the existing approaches towards user behavioral steering and (online) price discrimination.

Before starting the literature basis research, increasingly relevant developments such as the wide field of customer management and subsequently of ways to improve customer engagement have to be discussed.

Also, the trend towards increased foci in digital sales – both as a general trend and aconsequence of the COVID-19 crisis – are discussed. These background information enables the subsequent description of the approaches towards price discrimination and allow for more in-depth analysis and understanding of the processes behind them. This chapter also sees a summary of aspects directly influencing the usage of price discrimination policies – with both frameworks and theories focusing on the customer perspective (such as willingness to pay), society level (privacy and privacy laws) and the corporate perspective of technological developments (user-tracking, user experience development).

This necessary representation of the relevant frameworks, constructs and theories concludes the basic research framework of the thesis, allowing for a focused gaze towards the state of research on the different approaches towards price discrimination.

In a first step, an overview is presented therein, showcasing the different theoretical definitions of price differentiation and examples of work trying to structure the different approaches. These examples form the foundation for the subsequent detailed analysis of the existing state of research on the various approaches themselves. As the relevant approaches to price differentiation and discrimination are identified throughoutly, followed by a discussion in regards to their implementation, the thesis allows for a conclusion in regards to research question one and subsequently to form the foundation for the empirical work itself.

After the basis, the overall research strategy is described both in regard to the present data collection and to pre-existing research on the topic. This comparison of the actual approach utilized within the thesis and the approaches used throughout the studies described within the thesis aims to allow for valid interpretation of the data.

Data and Methods: General Approach and Research Strategy

For the present work – as the research framework already indicated – two distinct industries using online vendor systems were chosen – electronics stores and the travel industry. For the latter, empirical results regarding the influence of price discrimination seem already well established, as the introduction of this work pointed out. For the former, only generalized results implying that price discrimination is applied throughout many industries seem available.

"Any system wanting to perform large scale search for price discrimination has to parseproduct pages, extract he location of the price from web pages, and fan out queries to the same product page from other vantagepoints in order to compare the results."

Mikians, Gyarmati, Erramilli, Laoutaris, 2013, p. 2

This approach was also recognized and embraced within the underlying thesis: The main goal behind the research methodology is to foster understanding, which aspects of price discrimination are applied to different products at different vendors. The potential factors are derived from the scientific literature, with the research of Hindermann (2018) forming the foundation.

The author differentiates between different factors, based on which prices can be individualized. Hindermann (2018) names user-based aspects, such as recent on-page user behavior, the availability of a user account and information stored within it or the browser cache (cookies, browser history). Technical aspects include the operating system type or the differentiation between mobile and desktop devices. Also, the browser itself can be used as a way ofdifferentiating users. For the purpose of the thesis, apart from the general distinction between various operating systems (Windows, Mac, Linux for desktop devices; iOS and

Android for mobile devices) a distinction between various devices themselves will be made. Location-based price-discrimination will also be analyzed within the work. By using the available software different user-locations can be simulated, which is – in accordance with existing findings on the strong influence of user-location – one of the core goals to be defined in the work.

Following the approach described by (Rose & Rahman, 2015) simulated users will be in the center of this work. This approach offers two advantages to the researcher: By using simulated users that are created for the sole purpose of the study, a purely experimental paradigm is chosen, that is able to control all relevant variables easily and cannot be influenced by (probably unknown) previous behavior. Experimental designs are typically described to have high internal validity for this reason. However, external validity can in some cases be lower, due to experimental settings usually describing hypothetical situations. The simulated users for the present study are designed with this potential limitation in mind.

The second advantage of this approach lays in the research economy: Given the high number of variables that should be analyzed within this research, a observation-centered (thus based on real-life-observational instead of simulated users) design would imply the need for a very big sample and a huge workload on the participants. The simulations will be conducted using an own software developed by the researcher. The tool – as it was utilized within the study – is in its core basically a VPN tool that allows for origin spoofing, thus for simulating a different user location. Also, it allows to optimize user agents in regards to the aspects of price discrimination described here. For the purpose of this study, the software was used in an automated way, cycling throughout the variations regarding the individual variables. The prices of the products in the different iterations were protocolled by the software and exported to a .csv-table for the subsequent analyses.

Using this tool, the aforementioned factors will be applied to the products and product groups. Using regression analysis, the planned research aims to answer the main question, in which way various factors are influencing the pricing of products in different industries. The goal is, to be able to make quantitative statements, in regards to how, and to which extent these factors actually influence prices and whether different platforms and different industries show comparable results, thus indicating the state of implementation of dynamic pricing technology overall.

Data Collection and Variables

For the final data collection, two time-frames were assessed using the identical methodological approach. This step was introduced in order to a) showcase whether timing itself can influence prices and b) to assess whether the results found in the first assessment showed to be stable over time. In order to examine the time-based pricing effects, products and services were chosen that were available at both times of data collection. A total of four services had to be excluded from the research, as data was only obtainable at the first time frame.

Thus, in order to show only comparable results, these services were excluded from the analysis completely. A defined set of products and services from different vendors were selected. Products and services were chosen from two different vendors respectively, thus from two product vendors and two service providers. As the description of the data shows, the researcher aimed to assess products and services stemming from different price ranges, with the cheapest assessed product costing 8.99€ and the most expensive service costing 1600€. These products and services varied to different degrees in terms of their price variability across the different variations described in the thesis.

Modelling approaches are typically not able to obtain all necessary information, as observers in general are not able to make judgements based on perfect sets of information, authors such as Brunswik (1952) argue. Brunswik, known for the lens-model of judgement and assessment, argues, that not only do human agents typically not possess access to such perfect sets of information, but also they do typically not use all the information available to them when making judgements – rather they rely on pre-selected indicators based on their own informed guesses. For the sake of the present work this general limitation is acknowledged – the models presented here and used throughout the subsequently described empirical analysis do not claim to be

perfect or complete, but rather different approximations towards predicting prices.

In general, regressional models are typically used for such complex predictions. Bivariate approaches such as purely correlational approaches can be used in an exploratory phase to foster understanding, which indicators play a relevant role for predictions in general, however, due to their bivariate nature they are not able to account for complex inter-relationships like moderator or mediator effects. Regression analyses, authors as Geyer-Klingenberg, Hang, Walter and Rathgeber (2018) explain, are a viable tool to model such complex predictions.

III. Conclusions

The empirical results obtained from the thesis described above clearly indicate, that price discrimination or price differentiation are commonly used within the field of online sales.

While the influence of individual aspects of price discrimination – for example location- and user-based approaches – do seem to differ across products, vendors and timeframes, the general conclusion of the work seems clear: price differentiation is used and various approaches towards it are commonly combined.

This has managerial and consumer-related outcomes: For consumers, results showcased throughout this work clearly indicate, that their choice of operating system, their device used, their prior behavior on the according platform and – maybe most strongly – their location seems to be an influential factor in determining the prices.

How strong these individual effects are, seems to differ based on different variables. The underlying database was able to showcase the validity of the findings for two different time points: the same data collection was conducted with a separation of exactly two months. While results varied slightly the general outcome seemed unchanged. Users and consumers are therefore urged to use mobile devices for their online purchases: both for products and for services (and stable over time) these devices seem to be the favorable option for conduction of such transactions, showing significantly lower costs.

A bit less clear seem the results in regards to user location: while this approach of price discrimination is one intensely discussed both within scientific literature and the public, results showcased throughout this study seem to be of lesser clarity. While the country-effect proved to be of stable and robust significance across timeframes and type of goods – and also accounted for a majority of the significant interactions. The underlaying thesis also managed to showcase, that multiple price "optimization" strategies are typically in usage at the same time, thus, that vendors do not rely on one individual strategy (such as location-based approaches), but rather on an overall strategy that allows them to utilize the advantages of price discrimination on a broader scale (set of datapoints).

This is first and most predominantly indicated by the significant main effects of the individual price discrimination factors: The results show, that the individual measures are applied and have according effects. Also, statistical interactions between individual discrimination strategies could be observed, as the statistical analyses showcased.

Typically, those interactions containing the geographical location of users turned out to be of significant nature. However, this result cannot be interpreted in regards to the behavioral intentions of the vendors: While the results clearly show that such interactions between various price discrimination factors do exist, it remains unclear, whether these interactions are the result of a planned strategy aimed to utilize individual characteristics to optimize the effects of price discrimination or if they rather are the aftermath of the general implementation of such strategies.

The third research question thus can be answered from an overall perspective: The empirical research conducted over the course of this thesis alongside the results from the literature review shows, that indeed it is possible to develop a model of assessing the influence of various factors of price discrimination. However, as the subsequently presented limitations showcase, the data collection itself can be challenging and various factors could only partially be assessed.

The underlying work – apart from its distinct scientific contribution, as it was discussed throughout the sections of the thesis – aimed to provide a benefit for two distinct groups of economic actors – online vendors

on the one hand and online customers on the other hand.

The last part of this publication is to summarize the named benefits on a pragmatic level, thus aiming to accentuate the relevant outcomes for the respective groups.

First, conclusions can be made regarding online vendors and their specific challenges in this field. They need, as the present thesis showed, to find a perfect balance between an optimized price strategy for maximizing profit per customer, and minimizing the risk of negative feedback from (potential) customers. As shown in the thesis, ethical considerations and potentially negative effects of price discrimination might occur: Especially, in a business environment shaped by long-term relationships between companies and their customers, it might seem to be not the optimal strategy, to focus with a pricing strategy on individual transactions: While – as the empirical research showed – such an approach might lead to higher prices and therefore higher profits when considering individual transactions, there is a risk of thereby negatively impacting customer relationships. This can both be seen regarding existing relationships and potential backlash from media, where reports about such strategies might be seen in a less than favorable light.

For customers of online vendors the present work provides direct input on their decision making strategy: The empirical main results clearly indicate, that the price they are presented in a wide variety of online shops does not only depend on availability of products or the actual cost of them, but rather is a complex result of various price discrimination factors. In this regard, some of the influencing variables might be easier approached than others: It becomes evident, that the device chosen to conduct the purchase or the transaction seems to determine the price. Also, browser and browser history seem to be factors influencing the pricing strategy of companies, which at the same time might easily be adjusted by the shoppers themselves. More complex solutions – like VPNs – seem necessary to approach location-based price discrimination.

While the present work regarding these effects showcased significant effects, it still becomes evident that effects vary between vendors and products, thus implying that it seems crucial to make comparisons on an item-level: While here general effects of various devices or countries could be identified, for individual items contrasting and differing effects became visible, thus, the present results show tendencies that seem true on a generalized level, but that need particular attention on the level of individual transactions.

IV. References

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