

# Potentials and Influencing Factors of Dynamic Pricing in Business: Empirical Insights of European Experts

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**Abstract**—With a continuously increasing speed of information exchange on the World Wide Web, retailers in the E-Commerce sector are faced with immense possibilities regarding different online purchase processes like dynamic price settings. By use of Dynamic Pricing, retailers are able to set short time price changes in order to optimize producer surplus. The empirical research illustrates the basics of Dynamic Pricing and identifies six influencing factors of Dynamic Pricing. The results of a structural equation modeling approach show five main drivers increasing the potential of dynamic price settings in the E-Commerce. Influencing factors are the knowledge of customers' individual willingness to pay, rising sales, the possibility of customization, the data volume and the information about competitors' pricing strategy.

**Keywords**—E-commerce, empirical research, experts, Dynamic Pricing (DP), influencing factors, potentials.

## I. INTRODUCTION

THE increase of purchase processes and the speed of information exchange opens new possibilities for online retailers like dynamic price settings in which frequent and short time price changes become feasible [1]. Dynamic Pricing (DP) is primarily understood as a mere tactical retailer sided price setting process at individual transaction levels [2]. The non-negotiable prices can be easily and frequently adjusted over time as response to supply and demand [2], [3]. Dynamic prices are set by the retailer in order to skim what each buyer is willing to pay [2]. The goal of using Dynamic Pricing is to maximize the total profit [4]. The challenge of using personalized prices is to estimate customer's individual maximum price just below the price he is willing to pay and is able to purchase [4]. Customers' response to discriminating price settings might be negative because it violates a social norm [5]. Price changes within very short time periods are viewed as more unfair than price changes over a longer period of time [6]. Dynamic Pricing is associated with potential adverse effects on customers' perceived overall price fairness, trust and purchase satisfaction [7]. Customers' perceptions of fairness is crucial for businesses because it is connected with the overall satisfaction and hence with repurchase intentions of customers [8].

The objective of this article is to identify potentials which arise through the application of Dynamic Pricing in the E-

Commerce sector, specifically in the B2C-market. The potentials are analyzed by means of a quantitative empirical study based on a structural equation modeling (SEM) approach.

## II. DYNAMIC PRICING AND CUSTOMIZATION CRITERIA

Information technologies transformed the way businesses can respond and adapt to marketplaces [9]. Price strategies are capable of responding to information in real time due to the internet and big data [10]. The combined effect of a number of technological developments has enabled businesses to process data resulting from E-Commerce transactions faster and easier than before [11]. The scope of data processing can be extended even to non-transactional and unstructured data. Specifically cloud computing and big data allow the integration of new data sources quickly and with an extremely low effort [12].

Moreover, for capital-intensive services with a high proportion of fixed costs, the short-term bottom price is very low, often close to zero [13]. E-Commerce businesses that operate with low costs can apply Dynamic Pricing more extensively [14]. These retailers can respond to the price cuts of competitors without reaching the lower price limit [15].

It is obvious that the transition from a seller's market towards a buyers' market brings new challenges. Retailers need information about potential customers and their behavior as well as information about competitors. This allows them to react to market conditions and to determine the best dynamic price strategy [3]. It would be risky to implement Dynamic Pricing without understanding its influence on customers' reactions [2]. The more detailed information, the more consumer surplus can be skimmed off [16]. E-Commerce retailers can benefit from extensive information collected online about the customers [17].

Customers vary in terms of their location, their preferences and shopping behavior [18]. Dynamic Pricing offers a theoretically promising way to increase prices to those customers who are least price sensitive [2]. Thus, a crucial need for companies to charge a customer the right price is a wealth of information about customers and the ability to set and adjust prices at minimal costs [19]. Furthermore, there are the two main aspects of changed customer behavior: the higher level of information and the related increase in buying power. Customer awareness of a company's pricing policy allows the buyer to make strategic purchases. For instance, the buyer gains an ad-vantage by awaiting the purchasing of a product until prices are markdown. The retailers tend to suffer profit loss through this strategic customer behavior.

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Nowadays, the collection and analysis of internal and external data is simplified, mainly due to the digital revolution. Therefore, the following price differentiation criteria could be considered when using Dynamic Pricing [20].

TABLE I  
 CUSTOMIZATION CRITERIA ACCORDING TO TSCHUNKO [20]

Timing	Priority	Location	Distribution channel	Devices	Customer profile
High or low demand period	Booking at short notice	Stationary competition	Online benefits for discount campaigns	Manufacturer of the device or operating system	Web browsing behavior and history
Seasonal events like holidays	Shortage of supply	Overall economic situation	Booking via external websites	Mobile or stationary devices	Previous purchases
Purchase time of limited products	External conditions e.g. weather, exceptional circumstances	Depending on region e.g. infrastructure or public holidays			

Retailers can utilize these new types of information to make educated assumptions about their customers' characteristics [20], [21]. If retailers succeed in charging personalized prices, they must be careful not to offend those customers who might view this pricing tactic as inherently unfair [21]. The increased adoption and further development of Dynamic Pricing contributes to the increase of available demand data, to new technologies which simplify the ease of price changes and to the availability of decision support tools [19]. Especially, Dynamic Pricing models based on data mining offer great support to the strategic decision making processes [22].

### III. RESEARCH MODEL

The available literature has no previous research that investigates the potentials for E-Commerce retailers. Nevertheless, a number of scientific papers have investigated different aspects of Dynamic Pricing. The resources which are mostly rated within the VHB-JOURQUAL 3 Rating lay the basic foundation for the background of this study's hypotheses [23]. The following hypotheses have been formulated after collecting and analyzing information of related literature.

The recent developments of information technology enable online retailers to track and analyze customer behavior and promise valuable information about customers' preferences as well as greater insight into their true willingness-to-pay [24]. Through the integration of customer information, the real willingness to pay can be revealed [25]. Dynamic Pricing determines who gets the goods in times of highest demand favoring those willing to pay the most [13]. Therefore, the authors formulated the first hypotheses:

**H1: The knowledge of customers' individual willingness to pay positively influences the potentials of Dynamic Pricing.**

Online retailers can gather information at very low costs and have lower menu costs than stationary retailers. The Internet can decrease transition and transaction costs and simplifies the introduction of a wide spectrum of competitive strategies and pricing strategies [26]. The automation provided by digital technology makes it possible to adjust prices continuously to changing circumstances without any costs or efforts [27]. Improvements achieved by higher data quality and big data are lower processing costs, lower processing time and increased processing quality which leads to hypotheses 2 [11]:

**H2: Dynamic Pricing leads to savings.**

The main purpose of implementing new pricing concepts is to increase sales. For instance, the airline industry has been increasing its sales significantly since the introduction of revenue management [4]. Hence, Dynamic Pricing might improve the expected revenues and its profits which is formulated in hypotheses 3 [28], [29]:

**H3: Dynamic Pricing leads to an increase in sales.**

Nevertheless, customers decide whether they are willing to pay the current price or not. Dynamic Pricing affects those customers who get the goods in times of highest demand and favoring those who are willing to pay the most while creating further discounts for shoppers who can buy when prices are low [13]. Personalization on E-Commerce sites can be used to customize the prices, thus charging different prices to different customers for the same item [30]. Online retailers could meet customer's preferences better and increase their profits by using personalized pricing in the end which leads to the following hypotheses [31]:

**H4: Dynamic Pricing facilitates the determination of customized prices.**

The challenge for retailers is to recognize the correlation between price and market response through the collection of frequently updated sales data. They can immediately apply their improved knowledge about customer behavior by appropriately adapting the prices. Furthermore, the pricing decision could be significantly improved by taking into account the fluctuating nature of the market [32]. It is relatively easy to collect customer behavior data such as the visiting and the purchasing history as well as customers' preferences [33]. Data rich environments, like the E-Commerce sector, offer best conditions for optimization and personalization by marketing analytics [34]. In this context, the authors build hypotheses 5:

**H5: The potentials of Dynamic Pricing are interrelated with the volume of data.**

Competition influences the buying behavior of customers and affects the retailer's price setting. Dotcoms tend to differentiate themselves from multichannel retailers through pricing. Especially the competition among dotcoms tends to be on the price dimension [35]. Dynamic Pricing is preferable when the expected fixed price of the competitor is higher than the one of the company using Dynamic Pricing [36]. As a result, there are pricing strategies to maximize revenue while considering competitors' price settings formulated in

hypotheses 6 [37]:

**H6: Information about competitors' pricing strategy has a positive effect on the potential of Dynamic Pricing.**

In order to investigate influencing factors that might

increase the benefit of Dynamic Pricing in the E-Commerce, the empirical approach will focus on the hypotheses of the following model (Fig. 1):

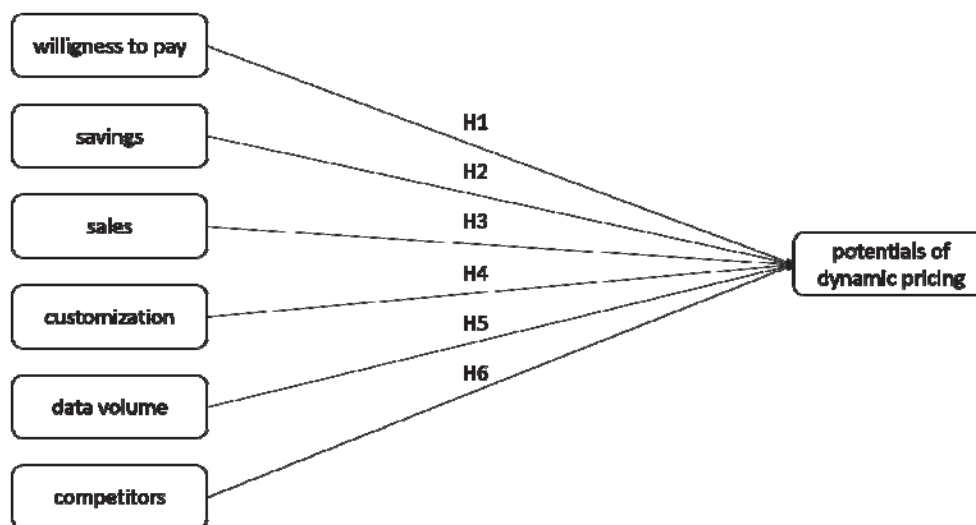


Fig. 1 Research Model

The related question within the online survey on a five Likert scale (1: very high; 2: high; 3: neither... nor; 4: low 5: very low) [38] are listed in Table II:

TABLE II  
QUESTIONS ACCORDING TO THE HYPOTHESES

Hypothesis	Question
<b>H1-H6</b> (Potentials of DP)	How high do you estimate the potentials of Dynamic Pricing in the E-Commerce sector in general?
<b>H1</b> (Willingness to pay)	How high do you estimate the possibilities of detecting customer's individual willingness to pay?
<b>H2</b> (Savings)	How high do you estimate general savings (e.g. cost, time, etc.) through Dynamic Pricing in the E-Commerce sector?
<b>H3</b> (Sales)	How high do you estimate the potential of Dynamic Pricing in the E-Commerce sector with respect to sales increase?
<b>H4</b> (Customization)	How high do you estimate information about customers?
<b>H5</b> (Data Volume)	How high do you estimate the influence of high data volume on the potentials of Dynamic Pricing in the E-Commerce sector?
<b>H6</b> (Competitors)	How high do you estimate information about competitors?

#### IV. RESEARCH METHODS

The data for this empirical quantitative study has been collected in Germany via an online questionnaire. The online survey has been generated by using the tool "Lime Survey", an online open source software to create, edit and analyze surveys [39]. To ensure high quality, a pre-test had been executed, and the questionnaire was improved based on the outcome. The target participants are experts from the fields of E-Commerce and/ or Marketing with special expertise in Dynamic Pricing. In order to examine the research model, the authors tested hypotheses to prove whether confirm or disconfirm the hypotheses [40].

The survey started in April 2016 and was completed in July 2016. The potential participants of this survey had been contacted via e-mail, telephone and the social network Xing. A total of 153 experts participated in the study. Finally, only fully answered questionnaires were considered. Hence, 50 incomplete questionnaires had to be eliminated resulting in an evaluable sample size of n=103.

The results of the general questions show that a share of 45 % of all experts are already using Dynamic Pricing and another share of 28 % are planning to use Dynamic Pricing within the near future. The level of experience in the field of E-Commerce as well as in the field of Dynamic Pricing was gathered.

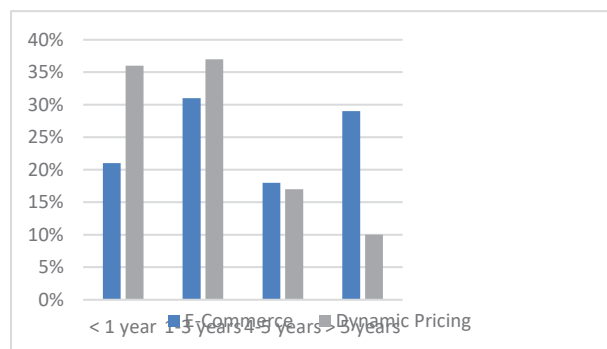


Fig. 2 Level of experience of interviewed experts

The analysis shows that the experts have less years of experience regarding Dynamic Pricing than regarding E-Commerce. Furthermore, the authors classified the industry sectors of the businesses the experts work for based on a selection of the European Classification of Economic

V.RESULTS

Activities (NACE Rev. 2) [41]. 31 % of all experts work in the wholesale and retail trade industry, followed by 13 % in the manufacturing industry. In addition, the majority of experts (52 %) work in businesses with less than 50 employees. The annual sales are less than two million Euro in 30 % of the businesses in which the experts are employed and another 42 % of the businesses' annual sales is between two and ten million Euro.

The results of the survey are analyzed by structural equation modeling to verify the proposed hypotheses. This approach allows statements about relationships between formally prepared appearance sizes of reality so that the validity via an empirically test can be subjected [42]. The SEM is created using a partial least square (PLS) approach and the statistical software Smart PLS (Version 3.2.6) [43]. The following model shows the weight of the path coefficients and the significance.

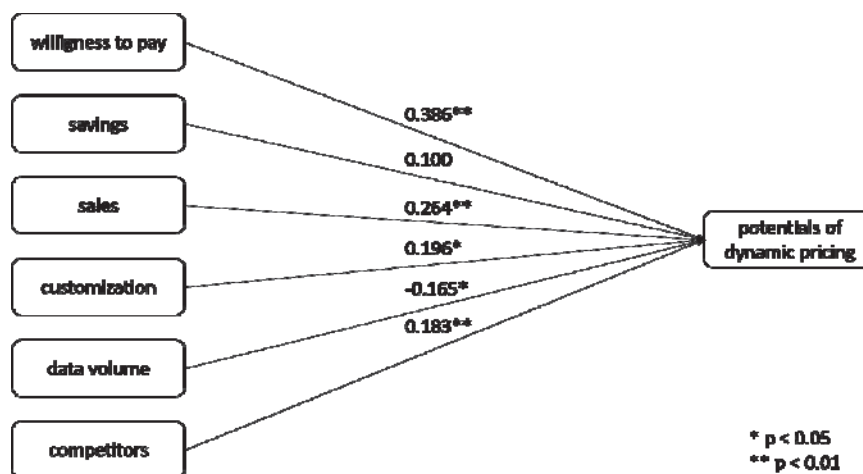


Fig. 3 Results of the Research model

According to the results of the SEM analysis, the first hypothesis (The knowledge of customers' individual willingness to pay positively influences the potentials of Dynamic Pricing) shows a p-value of 0.000 on a significance level of 0.01. The positive influence (+0.376) of this hypothesis is highly significant. Hypothesis one can be confirmed. The knowledge of the individual willingness to pay offers a huge potential for retailers Dynamic Pricing strategy. It allows to skim of the consumer surplus by customized prices in order to increase revenues.

The second hypothesis (Dynamic Pricing leads to savings) cannot be confirmed by the results. The positive influence (+0.100) of this hypothesis is not significant ( $p = 0.281 > 0.05$ ). Hence, this hypothesis must be rejected. The running expenses probably decrease over a longer period of time and not in the early stage of Dynamic Pricing. Generally, every implementation of new strategies takes some effort, which needs to be considered.

Based on the results of the SEM analysis, hypothesis 3 (Dynamic Pricing leads to an increase in sales) has a positive effect (+0.264) with a p-value of 0.007 on the significance level of 0.01. Therefore, this hypothesis can be confirmed. The increase of sales through Dynamic Pricing is a potential benefit for users of Dynamic Pricing strategies.

Regarding hypothesis 4 (Dynamic Pricing facilitates the determination of customized prices), the amount of information about customers and competitors show a positive influence (+0.021) on the potentials of Dynamic Pricing.

Hypothesis 4 can be confirmed as the result is significant ( $p = 0.042 < 0.05$ ). All information is only as good its analyzation. Information could be a potential benefit if it is used appropriately. Apparently, if customized pricing is perceived as transparent and fair, it has no impact on customer satisfaction

The influence of the volume of data on the potentials of Dynamic Pricing was discussed in hypothesis 5 (The potentials of Dynamic Pricing are interrelated with the volume of data). According to the SEM analysis, this hypothesis can be confirmed with a negative impact (-0.165) with a p-value of 0.046 on a significance level below 0.05. This shows that data volume negatively influences the potential benefit of Dynamic Pricing.

According to the SEM analysis, hypothesis 6 (Information about competitors' pricing strategy has a positive effect on the potential of Dynamic Pricing) shows a positive influence (+0.183). The result is significant with a value of 0.010 on the significance level of 0.01. Hence, this thesis can be confirmed. Having the information about competitors' pricing strategy influences the potentials of Dynamic Pricing positively. The knowledge offers a competitive advantage since especially in the E-Commerce the competition tends to be on the price dimension.

As a result, the SEM approach shows five hypotheses with a significant influence on the potentials of Dynamic Pricing in the E-Commerce sector. The significant influencing factors are the knowledge about customers' individual willingness to



pay, the increase of sales, data volume, customization and the information about competitors' pricing strategy. Only the hypotheses with respect to savings is not significant and had to be rejected. The values of all SEM Coefficients including the results of the t-test and the p-values of this model are shown in Table III:

TABLE III  
SEM COEFFICIENTS

SEM Path	Path Coefficient	T-Statistics	P-Values (Significance)
willingness to pay → Benefit of DP	0.386	4.180	0.000
savings → Benefit of DP	0.100	1.080	0.281
sales → Benefit of DP	0.264	2.727	0.007
customization → Benefit of DP	0.196	2.038	0.042
data volume → Benefit of DP	-0.165	2.003	0.046
competitors → Benefit of DP	0.183	2.592	0.010

In accordance to the literature, main quality criteria of structural equation modelling are the coefficient of the determination and Cronbach's Alpha [44]. Regarding the coefficient of determination (R Square), the results show a value of 0.51. As this value is higher than 0.19, the model absolutely fulfilled the quality criteria. With respect to the measure Cronbach's Alpha the value for all scales should be higher than 0.70. As the authors used single items within the research model, there was no need to calculate Cronbach's Alpha [45]. It must be noticed that it is allowed to use single items using the SEM approach and that single items are often used in research [45].

## VI. CONCLUSION

Dynamic Pricing is a very crucial topic and challenge for both practice and research. However, pricing of goods and services sold online becomes more and more dynamic than the offline pricing process [46]. Considering the research within this article, the authors gained some interesting results: there are five main factors influencing the potentials of Dynamic Pricing in the E-Commerce sector. These factors are the knowledge about customers' individual willingness to pay, the increase of sales, data volume, customization and the information about competitors' pricing strategy. From a managerial perspective, "Dynamic Pricing is best suited for products which are clearly specified or widely understood and that are either perishable (e.g. consumables) or time-sensitive (e.g. hotel room) or have a depreciating value (e.g. computer components, automotive parts)." [47]. Still, Dynamic Pricing can be applied to various products. On the other hand, practitioners should bear in mind that there are different types of information in order to make qualified assumptions about customers' characteristics.

Nevertheless, there are some limitations regarding the research as the survey included only the interviewed experts and was limited in terms of location, sample size and period of time. This study can serve as a basis for further studies. From a researcher perspective, there are additional aspects which can be found in future research including number of countries, the duration of the survey and/ or the sample size.

Additionally, a qualitative research approach can offer more detailed insights from experts as well as from the perspective of the customers. A focus on one specific industry sector within the E-Commerce presents a great opportunity for future research as well.

New developments within the area of digitization offer the ability to individualize retail prices. Within the increasingly competitive environment of the E-Commerce sector, the utilization of new techniques can strengthen profitability. For the foreseeable future, Dynamic Pricing will be an essential tool to secure success in the E-Commerce sector. It can be expected that the usage of this strategy will only increase, as it has not reached its full potentials yet.

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