Airline price discrimination: A practice of yield management or customer profiling?

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ABSTRACT

Prices of airline tickets frequently change, which is traditionally caused by yield management as price discrimination practice. In more recent times however, customer information is easily obtainable via the World Wide Web (e.g. through cookie data), which allows price discrimination based on customer profiling via cookie data or other electronic tracking tools. Consequently, a personal treatment might provide personalized ticket prices to customers.

This paper aims to investigate whether price discrimination practices are applied by airlines in online ticket sales. A month-long experiment was executed in which two European full-service and two European low-cost carriers were followed and prices of sixteen routes were tracked. First, customer profiling as underlying practice of price discrimination was tested by tracking prices at two conditions: one computer accepted cookies, while cookies and other online tracking tools on the second computer were erased after each session. If price differences between these two conditions had existed, these differences should attribute to customer profiling. Second, yield management as price discrimination practice could be investigated by tracking prices over time.

In this particular case, it was found that none of the airlines applied customer profiling based price discrimination since prices were identically the same at both conditions. Although customer-profiling tools were not used, customer information from direct sources such as online registrations are found to be crucial in segmentation processes. Other influences based on yield management were also identified. The two tested full-service carriers showed typical pricing patterns, whereas the two low-cost carriers did not show many fluctuations. Most changes occurred in the morning (56,5%) and the majority (52,2%) of fluctuations were minor price changes of 0%-5%.

Therefore in conclusion, the appliance of customer profiling as pricing practice is not confirmed based on this particular research. However, yield management seems to act as an underlying practice of dynamic pricing.

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Keywords

Customer profiling, dynamic pricing, price discrimination, yield management, airline prices, customer tracking

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1. INTRODUCTION

The airline industry is complex, whereas airlines are challenged to maximize sales of perishable assets: flight tickets. These are perishable as there is a certain date at which unsold tickets are lost. Due to this characteristic, airlines have to optimize their ticketing system, which should both decrease inventory of tickets and increase profits. Dynamic pricing seems to be a solution to achieve both objectives, which is seen as "a new version of an old practice: price discrimination" (Krugman, 2000). It causes that prices change over time, varying from customer to customer, and from various bundles of products and services (Kannan and Kopalle, 2001). The goal of dynamic pricing is not particularly to attract more money from customers (McAfee and te Velde, 2006), but to allocate the right price to the right capacity to the right customer at the right place at the right time (Kimes et al, 1998). Bitran and Caldentey (2003) acknowledge the importance of pricing and mention: "price is one of the most effective variables that managers can manipulate to encourage or discourage demand in the short run" (p. 204). Accordingly, dynamic pricing appears to not only influence profits, but also to regulate pressure on inventory. However, as prices frequently change, either over time or between customers or products, and customer awareness of these fluctuations increase due to the Internet, the question arises what underlying practices affect dynamic pricing.

Yield management as price discrimination practice has traditionally been applied by many airlines. This practice deals with the trade-off between selling a ticket immediately but at a low price, or waiting for a customer willing to pay more money but with the implied risk that in the end the ticket will not be sold (Alderighi et al., 2012). Literature has extensively discussed the concept of yield management, and mentions various mediators of this practice. These include supply (Birtan and Caldentey, 2003), costs (Klein and Loebbecke, 2000), competition (e.g. Currie et al., 2008), itinerary (e.g. Mantin and Gillen, 2011), and demand (Lieberman, 1993; Zhao and Zheng, 2000). Jointly, these factors help to define prices through yield management practices.

In more recent times however, customer profiling as price discrimination practice could be applied, since customer information is easily obtainable via the World Wide Web. This information may contribute to the process of charging the right price to the right customer. On the Internet, "customers themselves either directly or indirectly provide accurate, real time market data at virtually no cost to the firm" (Marmorstein, 2003, p. 158). Information that is directly obtained via customers themselves includes e.g. profile information (demographics, income, interests, family size), and purchase history. Indirectly, customer information could be obtained via tracking tools such as cookie data. These data provide any kind of information based on tracking a certain IP address (Bailey, 1998). Since an IP address is a unique identifier, companies are able to identify individual customers and related information as online search history. Both direct and indirect information sources might enable companies to offer a personalized price to customers. The role of direct information of customers on airline ticket prices has already been investigated and is often used to segment the market based on willingness-to-pay (Bailey, 1998; Bakos, 1998; Deck and Wilson, 2006; Grewal et al., 2004; Iyer et al., 2002; Klein and Loebbecke, 2000; Marmorstein et al., 2003; Taylor, 2002). However, there is not yet evidence on the role of indirectly obtained customer information on the prices of flight tickets.

In this research, airline price discrimination practices are explored, which primarily gives insight in the potential role of customer profiling and secondarily in the potential role of yield management as underlying practices of dynamic pricing. Based on a literature review and a month-long experiment both practices are investigated. In this research, the hypotheses *customer profiling affects airline ticket prices* and *yield management affects airline ticket prices* are tested.

This article is structured as follows. In section 2, a literature review first provides an explanation of dynamic pricing. Second, yield management and customer profiling are explained as potential price discrimination practices of dynamic pricing in the airline industry. Subsequently, the research methodology and results of this experiment are presented. In the last sections, the findings are discussed, together with the limitations of this study and possibilities for future research.

2. LITERATURE REVIEW

2.1 The concept of dynamic pricing

By its nature, an airline has to deal with a fixed capacity, variable and unpredictable demand, and perishable inventory (Kimes et al., 1998; Zhao et al., 2012). These characteristics challenge airlines to minimize inventory while simultaneously maximize profit (Malighetti et al., 2009). One technique to achieve those goals is dynamic pricing, which is often the only feasible method to ensure sufficient revenue to produce complex services, as it allows charging prices based on segmentation and differences in willingness-to-pay (Klein and Loebbecke, 2000). Due to dynamic pricing, companies are able to (re-) allocate resources and optimize occupancy (McAfee and te Velde, 2006).

Despite the appliance of dynamic pricing strategies by many airlines, information about the actual functioning is purposely withheld (Etzioni et al., 2002). Since the airline industry contains many carriers, an efficient pricing strategy may provide competitive advantage and should therefore not be shared with its external environment. However, literature has extensively discussed dynamic pricing. It aims at "allocating the right price to the right capacity to the right customer at the right place at the right time" (Kimes et al., 1998, p. 33). It might cause that ticket prices change several times a day or even an hour, which causes that passengers sitting next to each other in the same airplane may have paid different prices (Kung et al., 2002). Due to the Internet, it has become even more attractive for companies to apply dynamic pricing. Relatedly, Reinartz (2002) refers to price customization, which is defined as "charging different prices to end customers based on a discriminatory variable" (p. 55). Since the price of a relatively identical product differs (Lii and Su, 2009), it would be interesting to understand the underlying practice of dynamic pricing. Therefore, in the next sections, both yield management and customer profiling are discussed.

2.2 Yield management as price discrimination practice

Yield management was first introduced in the airline industry. According to Alderighi et al. (2012), it refers to "a broad set of techniques that are profitably used by such companies as

price discrimination policy when customers are heterogeneous, demand is uncertain and capacity is hardly modifiable" (p. 2). With yield management practices, airlines try to control prices and inventory, but also to improve service to each individual customer. Alderighi et al. (2012) mention various yield management techniques that could be implemented by companies, such as the capacity-driven approach (price based on remaining capacity), inter-temporal price discrimination (price based on heterogeneity of customers; in terms of willingness-to-pay and uncertainty in departure time), and time-driven approach (prices based on time before departure).

Yield management practices have extensively been discussed in literature and based on a literature review various mediators have been identified as influencers of this practice. The most frequently mentioned mediators are discussed in the next sections.

2.2.1 Supply

An airline's supply is based on its capacity, which is established in the long-term as an airline controls a fleet consisting of a certain number of airplanes. Birtan and Caldentey (2003) mention flexibility and perishability as moderators within this category. Flexibility in capacity enables airlines to relate supply to forecasted demand. Perishability relates to the ability to preserve capacity over time and is defined as inventory, which is the number of seats unsold at a certain point in time. The perishability of inventory is therefore translated into the date of the execution of a flight.

2.2.2 Costs

Airlines encounter a wide range of costs, which should be taken into account while determining prices. First, initial production costs, such as aircrafts, crew and fuel, are mentioned. Especially, the price of fuel heavily fluctuates and is reflected in the price of tickets. Second, marginal costs should be considered, which vary among the airplane's occupancy. Whereas services as catering depend on the number of passengers on a flight, these costs are dynamic. Third, individualization costs influence airfares. These costs occur when airlines implement booking and yield management systems. Especially due to the Internet, bookings can be done electronically and everyone with Internet access could buy a ticket him- or herself. These ticketing systems are costly, as they have to be integrated into the organization and its intermediary parties. Forth, shelf life costs should be taken into account. Since airline flight tickets are perishable, the overstocked seats will become worthless once the flight has been executed. All these costs should be taken together and should not exceed the airline's revenue in order to make a profit (Klein and Loebbecke, 2000). Lesk et al. (2008) argue that if more tickets are sold for a particular flight, it will be beneficial for the distribution of (fixed) costs, which means a higher number of tickets that will be sold at a lower price.

2.2.3 Competition

Competition appears to play a role in yield management practices, since prices could serve as a source for competitive advantage (Yelkur and DaCosta, 2001). According to Mantin and Koo (2009), competition intensity does not have an influence on pricing, however the presence of low-cost carriers (e.g. EasyJet and RyanAir) influences the competitive pressure on full service carriers (e.g. KLM and British Airways). competition on the route, the greater the change of price discrimination is. A monopolistic route is expected to show less changes, and may show the traditional segmentation of business – who value time and comfort – and leisure customers – who value price – as discriminatory variable (Borenstein and Rose, (1995). If a monopoly on the route changes into a situation of imperfect competition, price discrimination practices may increase.

The emergence of low-cost carriers has changed the market too as it has increased competition and it seems to fade the traditional distinction of leisure and business travelers (Teichert et al., 2008). Concerning leisure travelers, they may choose a ticket of a low-cost carrier instead of a full-service carrier, of which tickets are approximately 40%-50% more expensive (O'Connell et al., 2005). Concerning business travelers, it causes changes in their demand; on short- and medium-haul destinations a significant number of business passengers is willing to sacrifice certain services. This might cause that low-cost carriers also get business travelers on board (Martinez-Garcia et al., 2012). Full-service carriers should therefore adjust their business model in order to remain competitive. Frequent Flyer Programs, code sharing and minimization of catering services are examples of strategic movements (Alderighi et al., 2012; Dennis, 2007).

The integration of the Internet in customers' daily life has contributed to these movements, as the platform serves as a source of information about airlines, flights, and destinations. This information transparency leads to customer awareness of prices charged by competitors, which respectively increase price competition on sales (Currie et al., 2008). Malighetti et al. (2009) argue that prices are not heavily impacted by the presence of competitors; however understanding customers' behavior is essential in a competitive context. Also Feng and Xiao (2004) emphasize the understanding of the market environment, especially of consumer behavior, as fierce competition requires that airlines "offer comparable fares in each micro-market" (p. 18).

2.2.4 Itinerary

Another mediator is the itinerary that influences a ticket price. Destinations can be distinguished based on route length, containing short-, medium- or long-haul routes. According to Mantin and Gillen (2011), these groups have different pricing patterns, whereas long-haul flights evidently decrease in price within the price metrics. Vinod (2010) emphasizes on the details of the itinerary. Stopover charges, airport fees, security fees, service classes, types of trip (round trip or one-way), mileage provision, and tickets exchange are examples that may be reflected in the price of a ticket. The timeslot of a flight also seem to influence a ticket price (McAfee and te Velde, 2006). They argue that the highest prices are charged at flights performed during mid-day or early evening. Besides extra charges, fares can also be influenced by route frequency and the percentage of fully booked flights (Malighetti et al., 2009).

The nature of a destination may also be of influence, whereas leisure and business purpose can be distinguished. A destination such as Ibiza primarily attracts leisure rather than business travelers. A destination as London on the other hand may attract both segments. However flying to London often means a flight to a main airport as Heathrow or London City for business travelers and may be therefore be more expensive, but a ticket to a regional airport as Stansted or Luton for leisure travelers which is often offered by low-cost carriers (Papatheodorou and

2.2.5 Demand

Zhao and Zheng (2000) mention that one purpose of dynamic pricing is "to compensate for normal statistical fluctuations of demand" (p. 385). Since demand is uncertain, unpredictable and price sensitive, forecasting demand is a difficult task. McAfee and te Velde (2006) however name this task as crucial in the process of dynamic pricing. Lieberman (1993) recognizes the importance of this task in the hotel industry, which helps to identify potential low-demand days in advance. This should be communicated to marketing and sales departments, which could then take actions to attract customers of various segments on these days to maximize occupancy and profits. Heo and Lee (2011) argue that prices will be higher when demand is high, e.g. during holidays. When demand is lower, prices will be lower too which might cause that demand will be stimulated, e.g. during low season. Additionally, overbooking systems could be implemented, which protect airlines against no-shows and allows them to sell more tickets than there are seats available. Forecasts can be made based on information about cancellations, no-shows and last-minute bookings (Kimes et al., 1998).

Zhao et al. (2012) mention that prices are based on the remaining time before departure, on which contradicting opinions exist. Some authors believe that prices charged are higher when the departure date comes closer (Clark and Vincent, 2012; Malighetti et al., 2009; Mantin and Koo, 2009; Reinartz, 2002). However, other authors argue that first prices increase to attract risk-averse customers. After a period of time the price drops to attract more selective leisure customers who are price sensitive. This period is followed by a great increase of price, which charges price insensitive customers when the departure date comes closer (Anderson and Wilson, 2003; Mantin and Gillen, 2011; McAfee and te Velde, 2006). These price patterns may segment the market; while leisure travelers are generally price sensitive as they pay for their own tickets, business travelers value convenience and time and buy a ticket on a corporate account. Additionally, Puller and Taylor (2012) argue that ticket prices purchased on the weekend are lower than on weekdays; this measure might charge a lower price to price-sensitive travelers, which is based on the assumption that they tend to purchase a ticket in their free time, which is either in the evening or during the weekend. Besides, Zhao and Zheng (2000) notice that willingness-to-pay for a ticket increases when time before departure comes closer. As organizations recognize this behavior, flexibility to change prices becomes more crucial.

Last, the importance of selective measures should be considered (Feng and Xiao, 2004). Loyal customers are rewarded through loyalty programs or special discounts for members of designated classes. A distinction in non-refundable and refundable airfares could also be considered. According to the Feng and Xiao (2004), the most important question for companies is "which customer class should be served and at what price?" (p. 32). Since demand of customers may be different in the various segments, it is important to "develop multiple products or versions to generate more revenue by differentiation" (Kung et al., 2002, p. 282). Charging for additional services is a common method to serve customers' demand (Kimes, 1994). Loyalty measures may vary between full-service carriers and low-cost carriers, which use different strategies to satisfy customers' demand.

2.3 Customer profiling as price discrimination practice

Dynamic pricing causes price changes over time, varying from customer to customer, and from various bundles of products and services (Kannan and Kopalle, 2001). In order to implement this practice, information about customers is of crucial importance. Due to the integration of the Internet, it has become easier to obtain customer information, which simplifies the practice of customer profiling. Especially on an individual level, consumers can be identified by e.g. purchase history or zip code. Klein and Loebbecke (2000) call this process personalization. Personalization aims at identifying potential consumers and offering them the required products at the right time, price and conditions. Required information can be obtained via direct sources (e.g. consumer registration, logins, and purchase history) or indirect sources. What websites customers visit, how long they stay, what pages they view and what pages they visit next are examples of information from indirect sources. To collect this information, cookie files can be a valuable source (Alreck and Settle, 2007; Bailey, 1998; Berger, 2010; Campbell and Carlson, 2010; Deck and Wilson, 2006; Grewal et al., 2004; Iyer et al., 2002). Bailey (1998) defines a cookie as follows:

> "A cookie file is a "writable" file for the retailer on the consumer's client. Any information can be stored there and that information can be retrieved at some time in the future by the same retailer. Information stored at the retailer site involves tracking user's Internet Protocol (IP) addresses or requiring consumer to identify them when they access the server (p. 15)."

Whereas information from direct sources is provided with the explicit consent of consumers, information without explicit consent of customers could be retrieved via cookies or other electronic tracking tools (Dwyer, 2009). The usage of this kind of information could be seen as a breach of privacy. However, research has clarified that indirect information sources are used for marketing purpose, which is called behavioral targeting (Berger, 2010). With this practice, consumer's behavior is tracked via cookie data and consequently, advertisement or other services are customized based on this information. Behavioral tracking seems to go one step further. If customers are identified via electronic tools such as cookies, companies are able to get insight in a customer's search behavior. This insight could be translated into a customer's characteristics, which gives companies the opportunity to tailor pages, offers and prices meeting the customer's interest (Alreck and Settle, 2007, Bailey, 1998). Klein and Loebbecke (2000) call this concept of customer profiling "micro-segmentation" or "weblining", in which a company's offering on the web will automatically be differentiated based on electronic tracking tools. It allows companies to track searching and buying patterns in order to evaluate and forecast an individual customer's value. Based on these interpretations, it is possible to offer individualized deals. Krugman (2000) mentions that based on your "electronic fingerprint" you receive an offer, which might be either a bargain to potential price-sensitive customers or a premium to price-insensitive customers. This practice has also been explained by Kannan and Kopalle (2001), who argue that prices are personalized through customer information and mention, "processing of customer information enables dynamic pricing across customers based on their behavioral data" (p. 68). Taylor (2002) also believes that prices can be personalized based on customer information: "The

to identify individual consumers and charge them personalized prices" (p. 1).

Correct application of this practice may provide competitive advantage to a company. However negative consequences may occur too. If companies charge differentiated prices to individual customers based on customer profiling, customers might feel betrayed when they are aware of the fact that they have paid another (higher) price than another customer. This negative impact was seen at Amazon.com, which charged customized prices on e.g. books and DVDs. Since in this case customers were aware of customer-profiling practices by Amazon.com, they reacted negatively, which caused that Amazon.com abandoned this pricing practice (Kannan and Kopalle, 2001) They argue that the success of customer profiling based pricing discrimination depends on the nature of the product and argue that dynamic pricing of perishable goods is generally accepted, while dynamic pricing of nonperishable goods is not.

Although literature has acknowledged the existence of customer profiling based price discrimination, there is not yet evidence on the appliance in the airline industry. Online ticket sales however provide a great database of customer information, which could be used by airlines to personalize prices. Whereas prices of tickets frequently change, it could be perceived by customers that they receive a discriminative price based on their personal profile.

3. METHODOLOGY

First, this research investigates the potential role of customer profiling on price dynamics in online airline ticket sales. Therefore, a distinction between two types of customers has been made. An existing, regularly returning customer known to the airline by means of cookie data and a new customer, who is unknown to the airline (without cookie data) were distinguished. The experiment was executed through the use of two computers requesting ticket prices from four European airlines: two full-service carriers (airline 1 and 2) and two low-cost carriers (airline 3 and 4). The two users were asking the price of four destinations, three times a day simultaneously on fixed times, for a period of one month (April), which simulated two potential passengers looking for an online ticket with intended departure in August. The computers were two identical notebooks simulating two different conditions. In the first condition a regular notebook was used, which could belong to any random online user searching for a ticket price. On this notebook, cookies were enabled and in principle any online behavioral tracking was possible. In the second condition, the notebook was clean, and therefore no behavioral tracking information was available for customer profiling practices. In this condition, the notebook had a dynamic IP address, meaning that every time the user logged in a new IP address was generated. This made it impossible to track the system from the IP address. Furthermore this notebook was programmed to perform an automatic reset every time it was switched off (after each session). The reset resulted in erasing any traceable indications of previous online surfing behavior that could be used for the user identification even if the cookies were enabled. To make the comparison even more realistic, all search queries were executed simultaneously so that price variations between the two computers due to yield management would be impossible; in this case every difference in the price would be for all intents and purposes due to customer profiling. All prices were registered in an Excel sheet and by the execution of a two-sample T-test the hypothesis could be tested.

The initial intention was to check all four airlines for exactly the same itineraries, but this was not possible, because some of the routes were not flown by all airlines. All departures were from Amsterdam Schiphol Airport (airline 1, 2 and 4) or Eindhoven Airport (airline 3). Destinations of airlines 1 and 2 included New York, Barcelona, Bali and Istanbul. Destinations of airline 3 consisted of Stockholm, Barcelona, Rome and Dublin. Destinations of airline 4 were Zakynthos, Barcelona, Luxor and Istanbul. These different itineraries did not affect the validity of the experiment to answer the first hypothesis, because the actual itinerary is not relevant to this research purpose.

Second, because of the chosen research approach, it was possible to track price changes over time, which may occur due to yield management. By tracking prices during one month, it was possible to analyze a potential price pattern. Besides, it was investigated whether there was a potential difference between prices in the morning, afternoon and evening. Competition as mediator was investigated by analyzing pricing difference between the two types of carriers (full-service versus low-cost carriers).

4. RESULTS

4.1 Customer profiling as price discrimination practice

The first aim of the research was to find whether price discrimination of airlines was based on customer profiling due to obtaining information from cookie data or other user profiling methods. The results were manually registered into an Excel sheet that indicated no differences in the prices between both situations: the prices charged were identically the same at all sessions. Means and variations were also the same, and therefore the outcome of this test provides a p-value of 1,000 ($n = 54$, $t = 0{,}0000000$), obtained via a two-sample T-test for all sixteen flights (four destinations, four airlines). With this result, the hypothesis that prices differ based on cookie data or other profiling methods is rejected. Therefore, based on this result, it is assumed that the tested airlines do not use customer information from cookie data or other electronic tools as direct input for price determination.

4.2 Yield management as price discrimination practice

First, analysis of the data from the experiment provides insight in the role of competition as mediator. More dynamics in prices have been found at the two full-service carriers than at the two low-costs carriers. Whereas the low-cost carriers (airline 3 and 4) count for only nine changes (13%) in total, the full-service carriers (airline 1 and 2) together count for 60 changes, which is 87% (see appendix A.1). It may be that full-service carriers use more sophisticated pricing systems, while low-cost carriers manage a more stable pricing method since they already aim to charge low prices. While analyzing price dispersion, it was found that most price changes (52,17%) were between 0% and 5% and may be either a price decrease or increase. Within this category, most of the changes (75%) are between 0% and 1%, which means a minor change of a few euros or even eurocents.

between 5% and 10%, which is 27,54% of all changes (19 out of 69). Changes within this category are mostly found between 5%-6% (42,11%). Furthermore, some outliers are identified, which are showed at airline 1 and 3. Airline 1 has implemented a compulsory cancellation option in the second week of the experiment, which cannot be switched off. This measure might be the reason for two exceptional high price increases on a ticket to Bali (37% and 46%). This cancellation fee might be charged marginally. As the ticket to Bali is the most expensive one, its price increase might be the most extreme one. Airline 3 counts for an outlier on its Stockholm flight, which reflects a 40% price decrease in week 4. This might be caused by the fact that there is a holiday in this week and customers have a day off, which might cause that the airline aims to attract more leisure travelers on this day.

Second, based on this research, demand can be investigated. Consideration of price changes of full-service carriers roughly shows a pattern of price decrease in week 1 and 2, followed by a price increase in week 3, and finally price decreases in week 4. Airline 3 shows a price decrease at the end of the experiment on the flight to Barcelona. Besides, Stockholm is the only flight of this carrier, which shows a clear pattern of price increase in week 1 and 3, and a price decrease in week 2 and in the end of week 3. The other low-cost carrier, airline 4, does not show much variation in general, except a price decrease of 10 euros, followed by a price increase of 10 euros to the initial price on a ticket to Barcelona (see appendix A.2). Since the experiment stopped at the end of April, it was impossible to analyze this pattern for the remaining months in which time before departure comes closer and many price dynamics might exist. However the moment on which a ticket was searched might cause price changes as another moderator of demand. In the experiment, during 18 days prices have been tracked at three moments a day: morning, afternoon and evening. As the perception occurs that prices frequently change, and sometimes even multiple times a day (Kung et al., 2002), it would be of interest to discover whether there is a pattern in this pricing practice. Analysis of the number of changes shows that the majority of price fluctuations occur in the morning (UTC+1:00) at all airlines (39 out of 69 changes or 56,5%; see appendix A.3). Changes that occurred at the afternoon and in the evening counted for respectively 29% and 14,5%.

5. DISCUSSION

In this research, customer profiling and yield management as price discrimination practices were investigated. While investigating customer profiling, the results in two different conditions (new, anonymous customer versus returning customer) showed identical outcomes. Therefore, the assumption of Kannan and Kopalle (2001) that prices are personalized through customer profiling is not confirmed in this particular case. Whereas most airlines sell their tickets via the Internet and therefore customer information can easily be obtained via electronic tracking tools, this outcome was not expected. On the other hand, price discrimination based on cookie data or other electronic tracking tools might harm the relationship between customer and airline, which might be disruptive to an airline's reputation. Therefore, airlines may be careful with appliance of such practices.

Although the results of the experiment have not confirmed the use of electronic tracking tools, based on the literature it may be concluded that directly obtained customer information is used by airlines. Customer information obtained via e.g. a registered different customers. Direct information enables airlines to segment the market into price sensitive (more selective leisure customers) and price insensitive travelers (risk-averse or business customers) (Anderson and Wilson, 2003; Mantin and Gillen, 2011; McAfee and te Velde, 2006). This segmentation practice may be expressed in price differences based on time before departure and booking time. In this experiment, it was not possible to conclude that time before departure was an influencers, due to the limited length of the experiment. Based on booking time however, most changes were noticed in the morning (UTC+1:00). In relation to the finding of Puller and Taylor (2012) that tickets were cheaper on the weekend, it was expected that most price changes would occur during the evening to charge leisure travelers. However, this statement is not in line with the finding of the experiment.

Mantin and Koo (2009) mentioned that the presence of low-cost carriers might put pressure on full-service carriers. Therefore the full-service carriers might integrate complex yield management practices to charge dynamic prices to different customers. The results of the experiment show that full-service carriers were responsible for most changes (87%). The reason for this finding might be that full-service carriers focus on another segment. According to e.g. Anderson and Wilson (2003), full-service carriers segment their market in both business travelers (price insensitive) and leisure travelers (price sensitive). They are able to target both markets when they apply a dynamic pricing system, even though the majority of price changes were between 0%-5%. In principal, low-cost carriers charge low prices, which sometimes even count for a price difference of 40%-50% compared to full-service carriers (O'Connell et al., 2005). Although it seems apparent that both types of carriers have their own business model, the distinction between the business and leisure segment appears to fade, especially on short- and long-haul flights, as business travelers are willing to sacrifice certain services and start to make use of low-cost carriers too (Teichert et al., 2008).

In this experiment, it was found that customer profiling was not applied and price dynamics were more explicitly caused by yield management practices. However, customers might be aware of price changes and may be unsatisfied, as they cannot rely on stable prices. Since airlines do not provide much information about the functioning of these practices to preserve competitive advantage, customers may not be aware of the practice behind it. Therefore, it would be recommendable to airlines "to educate customers about the need for dynamic pricing: inventory clearance sales in the Internet domain, over a short time horizon, may result in dynamic prices for items" (Kannan and Kopalle, 2001, p. 79). Limited transparency about dynamic pricing might positively adjust customer's expectations. However airlines should be careful with the extent of information transparency, since pricing seems to be a source of competitive advantage (Etzioni et al., 2002).

This study provided some insights into the practice of dynamic pricing of airlines. The chosen approach of the experiment primarily focused on customer profiling, and secondarily on yield management. The conditions contributed to the validity of the outcome that in this case customer profiling has not been used to price discriminate; however not all mediators of yield management could be tested. Therefore, there are several limitations, as well as suggestions for future research. First, the study only used four of the many airlines that exist in the aviation industry. The tested airlines were all European. Other airlines both within and outside Europe were not considered. They might have another approach towards pricing strategies. Second, only a limited sample of destinations was considered

tickets to these destinations, but leave other destinations disregarded. Third, prices were only studied on working days. It might be that prices differ during the weekend or holidays as indicated by Teichert et al. (2008), whereas it might focus only on the leisure segment, instead of both business and leisure segments. Forth, this experiment was executed for only one month, in which time before departure is four months in the future. This characteristic limits the ability to analyze the possibility of segmentation based on time before departure.

Future research should take these limitations into account. First, an extension to a broader selection of airlines and destinations, in which e.g. price practices of American- and Asian-based airlines are also considered. Destinations might also act as a moderator, as carriers might segment destinations on leisure and business destinations. This distinction may cause lower or higher price dispersion. Non-direct flights might be investigated, since these are influenced by potential charges and prices of these related flight tickets could fluctuate. Next to these suggestions, the role of intermediaries may be researched. As this study has focused on prices charged on the website of the airline itself, investigation on potential influence of intermediaries could provide interesting findings. Furthermore, the moderator time before departure can be tested more extensively. As a contradicting opinion exists of the role of this moderator it would be interesting to investigate its influence, especially by distinguishing full-service and low-cost carriers. Future research may also investigate more extensively the purchase on part-of-the-day as moderator. Last, future researchers could also investigate if price differences are based on computer control systems, e.g. Windows and Apple Macintosh. The assumption of companies that Apple Macintosh users may have more money to spend could be a source of higher prices towards these users.

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APPENDIX

A. RESULTS FROM EXPERIMENT

A.1 Price fluctuations of all airlines in counts and percentages

PRICE CHANGE IN PERCENTAGE	PRICE CHANGE CATEG.	# PRICE INCREASE	# A.1	# A.2	# A.3	# A.4	# PRICE DECREASE	# A.1	# A.2	# A.3	# A.4	# TOTAL	% CHANGE OVERALL	% WITHIN CATEGORY
0%-5%		17	10	5	2	0	19	9	9	1	0	36	52,17%	
OF WHICH	*0%-1%*	*12*	*5*	*5*	*2*	*0*	*15*	*6*	*8*	*1*	*0*	*27*	*39,13%*	*75,00%*
	1%-2%	*1*	*1*	*0*	*0*	*0*	*1*	*0*	*1*	*0*	*0*	*2*	*2,89%*	*5,56%*
	2%-3%	*2*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*2,89%*	*5,56%*
	3%-4%	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0,00%*	*0,00%*
	4%-5%	*2*	*2*	*0*	*0*	*0*	*3*	*3*	*0*	*0*	*0*	*5*	*7,26%*	*13,88%*
5%-10%		10	1	8	0	1	9	2	6	0	1	19	27,54%	
OF WHICH	*5%-6%*	*4*	*0*	*4*	*0*	*0*	*4*	*0*	*4*	*0*	*0*	*8*	*11,59%*	*42,11%*
	6%-7%	*3*	*1*	*2*	*0*	*0*	*3*	*2*	*1*	*0*	*0*	*6*	*8,71%*	*31,58%*
	7%-8%	*1*	*0*	*1*	*0*	*0*	*1*	*0*	*1*	*0*	*0*	*2*	*2,89%*	*10,53%*
	8%-9%	*1*	*0*	*1*	*0*	*0*	*1*	*0*	*0*	*0*	*1*	*2*	*2,89%*	*10,53%*
	9%-10%	*1*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*1*	*1,46%*	*5,26%*
10%-15%		3	0	2	1	0	5	1	4	0	0	8	11,59%	
OF WHICH	*10%-11%*	*1*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1,46%*	*12,5%*
	11%-12%	*0*	*0*	*0*	*0*	*0*	*3*	*0*	*3*	*0*	*0*	*3*	*4,34%*	*37,5%*
	12%-13%	*2*	*0*	*2*	*0*	*0*	*1*	*1*	*0*	*0*	*0*	*3*	*4,34%*	*37,5%*
	13%-14%	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0,00%*	*0,00%*
	14%-15%	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*1*	*0*	*0*	*1*	*1,46%*	*12,5%*
15%-20%		1	0	0	1	0	2	1	0	1	0	3	4,35%	
OF WHICH	*15%-16%*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0,00%*	*0,00%*
	16%-17%	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0,00%*	*0,00%*
	17%-18%	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*0*	*1*	*1,46%*	*33,33%*
	18%-19%	*1*	*0*	*0*	*1*	*0*	*1*	*0*	*0*	*1*	*0*	*2*	*2,89%*	*66,67%*
	19%-20%	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0,00%*	*0,00%*

> 20%		2	2	0	0	0	1	0	0	1	0	3	4,35%	
OF WHICH	*20%-30%*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	0,00%	*0,00%*
	30%-40%	*1*	*1*	*0*	*0*	*0*	*1*	*0*	*0*	*1*	*0*	*2*	*2,89%*	*66,67%*
	40%-50%	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1,46%*	*33,33%*
	50%-60%	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0,00%*	*0,00%*
TOTAAL		33	13	15	4	1	36	13	19	3	1	69	100,00%	

A.1	= Airline 1
A.2	= Airline 2
A.3	= Airline 3
A.4	= Airline 4

A.2 Pattern of price changes for destinations with price change, per airline

Airline 1	Week	1			Week	2				Week	3				Week	4		
Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
New York																		
Barcelona																		
Bali																		
Istanbul																		

Airline 2	Week	1			Week	2				Week	3				Week	4		
Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
New York																		
Barcelona																		
Bali																		
Istanbul																		

Airline 3	Week	1			Week	2				Week	3				Week	4		
Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Stockholm																		
Barcelona																		
Rome																		

Airline 4	Week	1			Week	2				Week	3				Week	4		
Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Barcelona																		

= Price decrease

= Price increase

= Both increase and decrease on same day

= No change

A.3 Changes at each route per part of the day, per airline (in counts and percentages)

Airline 1	Morning	Afternoon	Evening	Total
New York	4 (57,1%)	1 (14,3%)	2 (28,65%)	7
Barcelona	1 (25,0%)	3 (75,0%)	0 (0,0%)	4
Bali	4 (50,0%)	3 (37,5%)	1 (12,5%)	8
Istanbul	2 (28,6%)	2 (28,6%)	3 42,8%)	7
Total	11 (42,3%)	9 (34,6%)	6 (23,1%)	26 (100%)

Airline 2	Morning	Afternoon	Evening	Total
New York	8 (57,1%)	5 (35,7%)	1 (7,2%)	14
Barcelona	2 (100,0%)	0 (0,0%)	0 (0,0%)	2
Bali	6 (100,0)	0 (0,0%)	0 (0,0%)	6
Istanbul	7 (58,3%)	4 (36,4)	1 (9,0%)	12
Total	23 (69,7%)	9 (27,3%)	2 (6,0%)	33 (100%)

Airline 3	Morning	Afternoon	Evening	Total
Stockholm	2 (40%)	1 (20%)	2 (40%)	5
Barcelona	1 (100,0%)	0 (0,0%)	0 (0,0%)	1
Rome	1 (100,0%)	0 (0,0%)	0 (0,0%)	1
Dublin	0	0	0	0
Total	4 (57,1%)	1 (14,3%)	2 (28,65)	7 (100%)

Airline 4	Morning	Afternoon	Evening	Total
Zakynthos	0	0	0	0
Barcelona	1 (50%)	1 (50%)	0	2
Luxor	0	0	0	0
Istanbul	0	0	0	0
Total	1 (50%)	1 (50%)	0 (0%)	2 (100%)

All airlines	Morning	Afternoon	Evening	Total
-	39 (56,5%)	20 (29,0%)	10 (14,5%)	69 (100%)