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Online Decision-Aids and Pricing: An Empirical Analysis of the Airline Industry

Eran Rubin
University of British Columbia, eran.rubin@sauder.ubc.ca

Benny Mantin
University of Waterloo, bmantin@engmail.uwaterloo.ca

ONLINE DECISION-AIDS AND PRICING: AN EMPIRICAL ANALYSIS OF THE AIRLINE INDUSTRY

AIDE A LA DECISION EN LIGNE ET FIXATION DE PRIX : UNE ANALYSE EMPIRIQUE DE L'INDUSTRIE AERONAUTIQUE

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Eran Rubin
Management Information System Division
Sauder School of Business
University of British Columbia
Vancouver, Canada
eran.rubin@sauder.ubc.ca

Benny Mantin
Department of Management Sciences
University of Waterloo
Waterloo, Canada
bmantin@engmail.uwaterloo.ca

Abstract

A large body of Information Systems research has shown that decision aids can have prominent effects on decision processes. In this respect, there is compelling support for the cost-benefit model, suggesting that cognitive effort can substantially affect decision strategy and outcome. In this paper we examine the implications of the model in the context of the travel industry. In line with the cost-benefit model, when a decision aid facilitates a strategy promoting the choice of low-price airline tickets, the probability that those tickets would be identified and, thus, purchased increases. This, in turn, should increase demand for the low-priced tickets and balance overall demand across flights. Therefore, we hypothesize that as the decision aid provided by a carrier requires less cognitive effort, variations in prices decrease and average prices increase. We empirically test our hypotheses by analyzing prices offered by US legacy carriers over 54 routes. The results broadly support our hypotheses.

Keywords: Decision aids, online purchase, cognitive effort, airfare pricing, price dispersion

Résumé

Dans cet article, nous cherchons à analyser le lien direct entre le prix proposé et l'aide à la décision du client dans le secteur de l'industrie aéronautique. En se basant sur le modèle coût-bénéfice, nous supposons que lorsque l'aide à la décision fournie par la compagnie aérienne est importante et requiert moins d'effort cognitif de la part du client, les variations des prix diminuent et la moyenne des prix augmente. Nous testons nos hypothèses en analysant les prix proposés par différentes compagnies aériennes américaines sur 54 destinations possibles. Les résultats obtenus confirment nos hypothèses.

Introduction

Online purchase adoption is unequivocal in the travel industry. Online travel consumers dominate in volume and account for about 83% of online US consumers (Henry 2007). Moreover, the prevalence of travel purchase online is continuously growing; According to a recent survey (Johnson 2007), online travel purchases are forecast to span $110.5 billion in 2009. The primary products travelers purchase online are airline tickets (Foss 2003).

The popularity of such purchases is not surprising as the reasons have been well studied in the Information Systems (IS) literature. Airline tickets are "low touch products", which do not require an offline presence prior to purchase (Chiang and Ruby 2003). However, airline tickets are attributed by an additional important characteristic which may have contributed to their prevalent purchase on the internet as well – their frequent price fluctuations.

Airline tickets are revenue-managed goods. That is, goods for which prices change dynamically as real-time demand is realized. While intuitively appealing for sellers, revenue management complicates the purchase decision processes for buyers. It may very well be that two tickets, which only differ slightly on travel date, will differ significantly in price. Thus, when airline tickets are purchased, information about alternative travel dates can have a significant effect of the consumer's decision.

When airline tickets are bought on the internet, online decision aids can provide relevant information pertaining to alternative travel dates. Rather than inconveniently interact with an impatient travel agent in search for less expensive tickets, consumers can use the internet. When useful information is effectively displayed online, the total search cost for the consumer can be reduced, more information can be incorporated, and a more informed decision can be made. To this end, enhanced decision processes taken by consumers are expected to affect the realized demand across different flights and thus also affect dynamic pricing practiced.

In light of this, the research question guiding our work is whether, and how, the extent to which information is provided by a decision aid on a carrier's website affects its airfare pricing. Exploring this question is expected to contribute to the understanding of online decision processes and the outcomes of using online decision aids. This analysis is also expected to contribute in understanding processes underlying dynamic pricing mechanisms in the airline industry.

More specifically, the major contributions of our research are in:

1) Validating previous IS research associated with decision aids using industry based data.
2) Extending previous work and suggesting new implications of decision aid use.
3) Improving our understanding about the interaction between decision aids and pricing.
4) Improving our understanding of the processes affecting airfare pricing.

In the context of flights, as information about alternative travel combinations is presented, consumers can find similar, alternative flights, with lower prices and lower experienced demand. Therefore, depending on their flexibility, consumers may end up purchasing less expensive alternatives rather than the more expensive, highly demanded ones. This process is likely to smooth the demand across flights, or at least divert some of the more elastic demand from busy itineraries to less congested ones. We, therefore, hypothesize that enhanced information is negatively correlated with variance in prices across travel dates. Furthermore, with better forecasts and balanced demand, fill rates of planes can also improve. Therefore, we also hypothesize that enhanced display formats are correlated with a higher average travel fare.

We test our hypotheses by analyzing a series of airfares from 54 US domestic routes offered by the main carriers. These carriers employ tabulated presentation format to exhibit travel options for date-flexible passengers. The number of options provided differs among the carriers. Our results show that the marginal effect of each additional alternative is highly significant, both with respect to the variance and with respect to the mean price of tickets.

The rest of this paper is organized as follows. In Section 2 we discuss online decision aids. In Section 3 we develop the research hypotheses. In Section 4 we describe the research design, and in Section 5 we analyze the findings. Finally, in Section 6 we provide concluding remarks and suggest directions for further research.

Background

Decisions taken in digital environments are highly dependent on the properties of the accompanying decision aids. Generally, decision aids provided in digital environments have the potential of helping users overcome their cognitive limitations, and, thus, extend their bounds of rationality. However, it has been shown that in practice decision aids can have other effects.

In essence, the design of a decision aid restricts the decision-maker to certain decision processes that are embedded into the system (Silver 1990). Within this restriction, a decision strategy is employed. Behavioral decision making literature (Payne et al. 1993), as well as a significant body of IS research (see Todd and Benbasat 1999 for a review), suggest that when using a computerized decision aid, the decision strategy employed by the user is highly dependent on the amount of effort it requires. According to this literature, the joint objectives of a decision-maker are to maximize decision quality and minimize effort. As these objectives often conflict, tradeoffs are made between the two (Todd and Benbasat 1999). Empirical studies, simulations, and conceptual literatures have all indicated that effort is the more important factor influencing strategy selection (Todd and Benbasat 1999). Interestingly, these tradeoff considerations seem to hold whether or not the user has high incentives to arrive at the optimal, or most accurate, decision (Beattie and Looms 1997).

Hence, according to the cost-benefit model, when analyzing a decision aid, the effort required while using the aid for decision tasks should be given as much attention, if not more, as the potential functionality of the aid (Todd and Benbasat 1994).

To this end, decision makers tend to use a two-stage process in choosing from large sets of alternatives (Payne 1976). Each stage demands its own decision strategy and the combination of the two strategies is, in effect, the overall strategy employed. In the first stage decision makers apply decision strategies to prune the decision search space, and in the second stage they switch to a more demanding decision strategy. The first stage is necessitated by cognitive constraints; people are willing or forced to forego decision accuracy to cope with the heavy cognitive load. The switch to the second stage is motivated by a desire to use the cognitively more demanding strategies so that high decision accuracy can be obtained.

For web based decision aids, a factor imposing several differences in decision effort is the concentration of information on a single web page versus its dispersion across several pages. Namely, concentration of information on a single page reduces decision effort for three reasons – it reduces cognitive effort; it reduces the time required for search; and it enables easier integration of information.

With respect to cognitive effort, when information is spread over several web pages, the overhead associated with the task of searching and browsing for the information increases. Bettman et al. (1990) predict that cognitive effort is a function of the number of elementary information processes required to execute a particular decision strategy. Accordingly, tasks such as mouse movement, keyboard use, and scrolling impose increasing cognitive effort, which decision makers try to reduce. Indeed, Hoque and Lohse (1999) provide evidence for the effect such cognitive effort has on decision making in web based decision tasks. However, when information is found on a single page, more information can be incorporated with minimal effort into the decision making process.

With respect to search time, the web's infrastructure introduces important constraints on multi-page browsing. Response time during web navigation takes away from the time that can be devoted to the actual decision task (Dennis and Taylor 2006). As well, interrupting decision tasks in the favor of search can have a negative impact on decision performance. Namely, with delays, a sense of time pressure may emerge (Arnold et al. 2000; Payne et al. 1996), which may result in a psychological burden termed disutility, stress, or dissatisfaction (Dennis and Taylor 2006; Reinhard 1997; Speier et al. 1999). Indeed, research has noted a negative relationship between performance evaluations and web-induced delays (Khosrowpour and Herman 2000; Lightner et al. 1996). While short delays may be acceptable, when delays are relatively long, as in the case of flight search queries, these effects are more likely to appear.

Finally, with respect to information integration, when information is disparate across several web pages, the decision maker is either forced to rely on memory or invest more effort to keep track of previously accessed information. Hence, once again, dispersion of information across multiple pages has increasing demands on decision efforts.

To summarize, limited presentation formats, that provide the consumers with departure and return date alternatives, may critically narrow the feasible search employed. Hence, due to limiting display features of the decision aid, a better low price option may not be selected.

Research Hypotheses

When consumers shop for a flight, a decision strategy guiding their purchase needs to be employed. Considering a two stage process, at the first stage a strategy determining the number of alternatives to be evaluated is applied. For example, one may consider only deviations of up to one day from a predefined departure date, while another may consider deviations of up to 6 days. At the second stage, alternatives are evaluated and a choice between them is made. Different strategies can be applied at this stage as well. For example, one may search for flights until a specific predefined price threshold is met (known as the LEX strategy). Yet, another may examine all flights from the defined search space and compare them (for example using the WAD strategy). [1]

In the airline industry, upon searching airfares for a trip, the airlines' websites would traditionally provide passengers with combinations ranked on prices or time characteristics (time of departure or duration of the travel) only for the travel dates indicated by the user. Recently, however, the airlines have started offering the date-flexible consumers alternatives to their originally-searched travel dates. These flexible search modes provide the consumers with a tabular overview of an extensive number of combinations of departure and return dates at once. These formats provide the consumers with a quick reference to the lowest priced tickets in the days immediately before and after the requested departure and return dates.

Under the new presentation formats for the date-flexible consumers, differences are noticed. Some carriers provide on a single screen the prices of the trip on a combination of 49 different dates (7 departure dates and 7 return dates), others provide a combination of 25 different dates, and some provide a combination of only 9 different dates. The more combinations displayed on a single table, the less effort required in executing a decision strategy pertaining to an exhaustive search of relevant alternatives. This variation provides us a unique opportunity to examine economic outcomes resulting from variances in the supplied information to support purchase decisions.

Figure 1 illustrates two such presentation formats as employed by Delta Air Lines and Northwest Airlines. Clearly, Northwest's format offers many more alternatives. It would require a Delta consumer more than 4 searches to obtain an equivalent coverage of alternative travel dates. Northwest imposes a consideration of more alternatives (based on a possible departure\return date criterion). Furthermore, if the same number of alternatives is considered by a Delta customer, Northwest still makes it easier to examine all prices within the considered search space (rather than use a strategy such as LAX).

Fostering a more exhaustive search strategy suggests important implications on demand differences across travel dates. The higher the probability that an exhaustive search strategy would be employed by date-flexible consumers, the higher the probability that the low priced flights would be noticed and purchased. In turn, as demand for low-priced tickets would increase, their price would naturally increase as well. Such a process eventually reduces differences in airfares on the same route for different travel dates. Deviating to alternative travel dates depends, of course, on the magnitude of the price differences between the alternatives. The larger is the price difference, the more attractive the cheaper alternative would be.

It should be noted that the even if price is not the core differentiating factor, but the consumer is not totally price insensitive, such a process is expected to take place. For example, if time of day is the core differentiating factor for a consumer, and there exist two flights that take place at comparable times of day on different dates, then there is some incentive for that consumer to divert to the cheaper flight.

According to the above, as an exhaustive search strategy becomes easier to employ, price differences across travel dates for the same route are expected to be lower. Formally, our first hypothesis states:

Hypothesis 1: The more travel date combinations displayed by a carrier on its website, the lower is the variance of the lowest prices across travel dates on a specific airport-pair.

These effects on demand variability have important implications associated with carriers' ability to generate revenue. As more alternative travel dates are presented to consumers, the carrier enables more of them to divert to

[1] A review of different decision strategies can be found in Svenson (1979).

less expensive alternative dates. As this smoothes the demand across dates, and fill rates improves, the average price charged increases accordingly. Hence, our next hypothesis:

Hypothesis 2: The more travel date combinations displayed by a carrier on its website, the higher is the average of lowest price of airport-pair provided by the carrier across different travel dates on a specific airport-pair.

Delta's 3X3 matrix

Leave	Return ▸ Fri Mar 21	Sat Mar 22	Sun Mar 23
Fri Mar 14	LOWEST $200 Nonstop	LOWEST $200 Nonstop	LOWEST $200 Nonstop
Sat Mar 15	$242 Nonstop	$242 Nonstop	$242 Nonstop
Sun Mar 16	$315 Nonstop	$315 Nonstop	$315 Nonstop

Northwest's 7X7 matrix

	Returning: Wed, Mar 19	Returning: Thu, Mar 20	Returning: Fri, Mar 21	Returning: Sat, Mar 22	Returning: Sun, Mar 23	Returning: Mon, Mar 24	Returning: Tue, Mar 25
Leaving: Wed, Mar 12	From $351 1 Stops	From $374 1 Stops	From $469 1 Stops	From $466 1 Stops	From $459 1 Stops	From $374 1 Stops	From $426 1 Stops
Leaving: Thu, Mar 13	From $299 1 Stops	From $321 1 Stops	From $416 1 Stops	From $414 1 Stops	From $406 1 Stops	From $321 1 Stops	From $374 1 Stops
Leaving: Fri, Mar 14	From $334 1 Stops	From $356 1 Stops	From $451 1 Stops	From $449 1 Stops	From $441 1 Stops	From $356 1 Stops	From $389 1 Stops
Leaving: Sat, Mar 15	From $334 1 Stops	From $356 1 Stops	From $451 1 Stops	From $449 1 Stops	From $441 1 Stops	From $356 1 Stops	From $389 1 Stops
Leaving: Sun, Mar 16	From $384 1 Stops	From $406 1 Stops	From $501 1 Stops	From $499 1 Stops	From $491 1 Stops	From $406 1 Stops	From $439 1 Stops
Leaving: Mon, Mar 17	From $296 1 Stops	From $319 1 Stops	From $414 1 Stops	From $411 1 Stops	From $404 1 Stops	From $319 1 Stops	From $351 1 Stops
Leaving: Tue, Mar 18	From $276 1 Stops	From $299 1 Stops	From $394 1 Stops	From $391 1 Stops	From $384 1 Stops	From $299 1 Stops	From $331 1 Stops

Figure 1: Two website displays of flexible flight search, as offered by Delta Air Lines and Northwest Airlines

Research Design

Data

Our sample includes airport-pairs derived from the index of major airports provided by the Federal Aviation Administration (www.fly.faa.gov). These major airports represent the backbone of the US domestic airline network and responsible for a major share of the passenger transportation. Furthermore, all legacy carries studied in this research provide service between these airports. From this set of airports we have excluded airports with direct competition from other nearby major airports. In particular, we have excluded airports in the cities of Chicago, the New York area, San Francisco, and Miami. We have collected airfare data on a sample of 54 different domestic routes between these airports. We have further aimed at incorporating routes of varying distances, as well as incorporating a set of routes that covers a wide range of geographical areas from continental US.

Our analysis focuses on legacy carriers. Specifically, our attention is limited to the "Big Six": American Airlines, Continental Airlines, Delta Air Lines, Northwest Airlines, United Airlines, and US Airways. Therefore, for each of the routes sampled, we have collected the lowest offered one-way airfares for different departure dates, as offered by each of the relevant legacy airlines. The one-way fare was collected in order to eliminate restrictions that airlines may pose, such as the Saturday night stay.

Collection of price information was done from a single source to assure consistency in data across airlines. In this regard, in line with McAfee and te Velde (2007), we have collected daily airfare data from a Global Distribution System (GDS) provider rather than from online travel agencies. In order to capture differences in variance we have sampled airfares when prices are most volatile – the final two weeks prior to flight departure (Sin et al. 2007).

In brief, a GDS collects updated airfare and availability data from different airlines and distributes the data (or part of it) to travel agencies. As such, a GDS has better access to tickets offered by various carriers than online travel agents. A GDS also provides the complete offering of tickets available from each carrier.

Our sample comprises the airfares as offered by each of the sampled carriers for flights taking place on different dates, on each of the 54 routes. This sample was constructed by gathering lowest price airfares for flights on the different routes, departing on different dates in a range of two weeks2. Observations were evenly distributed between carriers and routes. Specifically, approximately 14 observations, one for each travel date, were collected from each airline for each route, yielding a total of about 750 observations per airline, and 4531 price observations in total.

Table 1 provides summary statistics on the sampled data. The table shows that our sample incorporates a wide range of ticket prices. The top 5% price in the sample is 785 dollars, while the bottom 5% price is 135 dollars.

Table 1. Sampled Data

Airline Carrier	No. of Observations	Mean	Standard Deviation	Coefficient of Variation	Percentile		
					5th	50th	95th
American Airlines	756	375	179.5	0.48	160	334	748
Continental Airlines	753	437.3	239.9	0.55	160	374	884
Delta Air Lines	756	337.5	161	0.48	133	301	639
Northwest Airlines	756	583.8	202.6	0.35	225	596	902
United Airlines	754	324.9	171.7	0.53	132	286	594
US Airways	756	282.3	172.1	0.61	108	243	613
Total	4531	390.2	219.9	0.56	135	332	785

Model

Our dependant variables measuring the variance of prices are the ***Coefficient of Variation (CV)***, and ***Relative Price Range (RPR)***. Basically, CV measures the variance of prices, normalizing the value by the corresponding mean. RPR is a measure of the price range of an airline on a route, scaled by the price range observed on the route when all airlines are considered. Both CV and RPR are commonly used in the literature as dispersion measures (e.g., Baye et al. 2006). Finally, our dependant variable measuring the price level is the ***Price Mean***, which is an average of the lowest prices observed in the relevant sample.

The control variables used in our study are grounded in airfare pricing literature. According to this literature, variables affecting airfare prices can be classified into three broad groups: market structure variables, route characteristics, and carrier-specific variables (see, e.g., Cho et al. 2007).

Market structure variables try to encompass the competitive environment of the market. The most common variable in this category is the ***Herfindahl-Hirschman Index (HHI)*** which quantifies market concentration. In our analysis, the measure HHI is calculated based on Farecast.com's market share values. A second market structure variable used in our analysis, ***LCC***, is a dummy variable which captures the existence of a Low Cost Carrier (LCC) on the non-stop route. This variable is incorporated since it has been shown that LCCs negatively affect the average price charged by carriers (Tretheway and Kincaid 2005).

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[2] In order to eliminate seasonal effects we did not include long periods of times in a single sample (sin et al. 2007). In any case, when including longer time periods (tested up to 6 weeks) we obtained qualitatively similar results.

With respect to route characteristics, two main variables typically used are the distance between the airport-pair and the populations of the metropolitan areas served by the airports. The ***Distance*** variable used in our analysis is based on a great circle route application and is measured in kilometers. Population values are extracted from Census Bureau in line with the method used by Gerardi and Sahpiro (2007). Our ***Population*** variable corresponds to the arithmetic mean of the populations to capture the projected volume of passengers on the route.

Carrier-specific variables consider the unique characteristics of the different airlines that are consistent across the different routes. Most of these characteristics are naturally controlled for in our analysis since our samples is based on legacy carriers only. These carriers share similar structural costs, operate similar networks and offer similar product segmentation (i.e., class fares). However, since all of these carriers operate their flights in a hub-and-spoke type of networks, the location of carriers' hubs still needs to be controlled for. Having a hub at either end of the route offers the carrier much more versatile routing opportunities due to connecting flights. We account for such possible difference in our analysis by incorporating ***Hub on Route***, a dummy variable which indicates the presence of a hub at either the origin or the destination for a given carrier (see, e.g., Geradi and Sahpiro 2007).

Finally, based on our analysis, in this paper we propose a new carrier-specific variable affecting pricing - the presentation formats employed by the carrier. To quantify this proposed variable, we have analyzed the websites of the major six airline carriers on the number of alternatives provided on a screen when the consumer undertakes a flexible flight search. Our review of carrier websites reveals that five of the six legacy carriers provide a grid of alternatives. The number of options provided by these carriers varies across airlines from 9 to 49 options. American Airlines is the one airline which differs slightly in this regard. It does not provide a grid but rather separates departure and return options in a flexible flight search, wherein it provides only 7 options on a screen.[3]

These differences are quantified in our analysis using the ***Flexibility*** variable, which corresponds to the total number of alternatives offered by the carriers on a single search.

Table 2 provides summary statistics for the different explanatory variables in our sample. It can be seen that the sampled routes connect densely populated areas, thus incorporating airports servicing major metropolitan areas. Low Cost Carriers (LCCs) offer flights in 31 of the sampled routes, while in the remaining 23 routes there is no presence of these LCCs. The different routes exhibit different levels of competition, with the top 5% HHI parameter set at 0.73 and the bottom 5% set at 0.39. Finally, the distance of the routes varies as well, with a median distance of 1441 kilometers.

Table 2. Model Variables

	No. of Observations	Mean	Standard Deviation	Percentile		
				5th	50th	95th
Flexibility	4531	24.65	18.2	7	9	49
Population (m)	4531	3.608	1.378	1.813	3.506	7.253
LCC (dummy)			31 Routes			
Distance (km)	4531	1660	881.4	528	1441	3496
HHI	4531	0.396	0.151	0.22	0.37	0.73

Results

When analyzing airfares, possible correlation between errors must be accounted for. More specifically, the unique characteristics of each route may result in correlated price offerings by the different carriers on the same route. Similarly, the pricing strategy of a carrier may result in correlated price offerings by the carrier on different routes.

[3] Since American Airline is the only carrier not providing a grid of options we have tested our results on a sample not including American Airlines – the result are qualitatively the same.

Failure to control for such clustering of errors can lead to massive under-estimated standard error and consequent over-rejection using standard hypothesis test (Cameron et al. 2006). We, therefore, account for such possible correlations by analyzing our data using a two-way clustering method, clustering errors both by routes and by carriers. To this end, the two-way clustering method suggested by Peterson (2008) and Cameron et al. (2006), which is commonly applied in the literature (e.g., Rubin 2007; Strebulaev 2007), was applied in our analysis[4].

Our first hypothesis is that flexibility is negatively correlated with the variance in prices exhibited by a carrier, for flights on the same route offered on different dates. Table 3 presents regression results for different specifications where the dependent variable is the coefficient of variance. Quite profoundly, we find that the presentation format of the flexible choice employed by the carriers on their websites affects price variation. In all specifications the coefficient of variance is significant at the 1% level and negatively correlated with flexibility. We also note that consistent with the literature (Gerardi and Shapiro 2007) the competition intensity in the market negatively affects price variation.

Table 3. Variance of Prices and Decision Aid Display

Coefficients and t-statistic (in parentheses); + significant at 10%; * significant at 5%; ** significant at 1%.

	(1)	(2)	(3)
Dependent variable	Coefficient of Variation	Coefficient of Variation	Coefficient of Variation
Flexibility	-0.0036 (-3.63)**	-0.0036 (-3.69)**	-0.00379 (-3.7)**
HHI	-0.2023 (-2.28)*	-0.194 (-2.17)*	-0.16991 (-1.91)+
Distance	-0.013 (-0.77)	-0.0128 (-0.78)	
Population	0.0112 (0.9)	0.0115 (1.01)	
Hub on Route	0.007 (0.4)		
LCC (dummy)	-0.0046 (-0.11)		
Constant	0.4216 (4.7)	0.4149 (7.84)	0.42 (10.97)
N	324	324	324
R-squared	0.1485	0.1482	0.1401

In the next set of tests pertaining to the relation between flexibility and variance we examine relative price range as the dependent variable. Once again the flexibility parameter is significant at the 1% level in all specifications. We

[4] With the exception of the analysis of the Relative Price Range. When analyzing specifications pertaining to Relative Price Range, clustering by route is obsolete. Since this measure inherently distributes observations in a uniform manner at all routes (due to the scaling by the route's range), correlated price range errors within a route do not emerge. Therefore, Relative Price Range errors were clustered only by carrier. In any case, when applying a two-way clustering method the results are qualitatively the same.

also find a negative correlation between relative price range and the operation of a low cost carrier flights on the route. Nonetheless, flexibility is most significantly correlated with relative price range, suggesting that the flexibility parameter is an important contributor to variance in this parameter.

Table 4. Range of Prices and Decision Aid Display

Coefficients and t-statistic (in parentheses); + significant at 10%; * significant at 5%; ** significant at 1%.

	(1)	(2)	(3)
Dependent variable	Relative Price Range	Relative Price Range	Relative Price Range
Flexibility	-0.004 (-4.15)**	-0.004 (-4.2)**	-0.004 (-4.2)**
LCC (dummy)	-0.086 (-1.96)	-0.088 (-2.04)+	-0.057 (-2.56)+
Population	-0.013 (0.9)	-0.012 (-1.43)	-0.012 (-1.44)
HHI	-0.173 (-1.15)	-0.185 (-1.2)	
Distance	0.011 (-0.74)		
Hub on Route	0.007 (1.45)		
Constant	0.762 (7.87)	0.788 (7.65)	0.69 (16.85)
N	324	324	324
R-squared	0.101	0.097	0.089

We next examine whether the supported pricing mechanism enables an increase in the average lowest available airfares. Table 5 shows results of regression specifications in which the dependant variable is mean price of the lowest fare available.

In all specifications the flexibility variable is positive and significant at the 1% level. Not surprisingly, other variables are found to be highly significant as well. Specifically, consistent with the literature, it appears that the presence of competition stemming from a low cost carrier on the same route significantly reduces the lowest price offered by other carriers. We also find that, quite naturally, as the distance between the connected airports increases, the average nominal airfare increases accordingly. Finally, as briefly discussed earlier, operating a route that has a hub on either end, benefits from the network externalities of the carrier which allows this carrier to charge a higher price.

Table 5. Mean Price of Lowest Fare and Decision Aid Display

Coefficients and t-statistic (in parentheses); + significant at 10%; * significant at 5%; ** significant at 1%.

	(1)	(2)
Dependent variable	Mean price of lowest fare	Mean price of lowest fare
Flexibility	4.39 (2.77)**	4.35 (2.78)**
LCC (dummy)	-129.48 (-5)**	-95 (-3.57)**
Distance	32.6 (3.53)**	
Population	-32.71 (-4.56)**	
HHI	30.39 (0.68)	
Hub on Route	25.9 (2.14)*	
Constant	403.2 (7.67)	337.5 (8.7)
N	324	324
R-squared	0.314	0.25

Concluding Remarks

In this paper we argue that presentation formats deployed on a vendor's website can affect consumers' decisions and thereby influence the vendor's experienced demand. By reducing the cognitive effort involved in the search process for alternative goods, vendors effectively encourage consumers to evaluate a wider range of alternatives prior to purchase, thus allowing them to reach better decisions. This process, which permits self selection of consumers to the appropriate alternative, directly affects demand for the different products and indirectly influences their pricing.

Studying legacy carriers in the US domestic airline industry, we have observed that the different carriers offer tabulated results for date-flexible consumers to different extents. While some carriers allow a search incorporating only the immediate nearby days, others incorporate a whole week of departure and return combinations.

We hypothesize that extended presentation formats decrease the variation of prices and increase the average price charged. The results presented in this research support our hypotheses. That is, in the sampled formats, as more alternatives are presented to the user, the variance in prices reduces and the carriers are able to charge, on average, a higher price for trips.

Our hypotheses are derived from previous work done in the IS literature on the relevance of the cost-benefit model when analyzing decision support tools. Notably, previous IS work that empirically evaluated decision aids have employed laboratory based empirical designs. To the best of our knowledge, an empirical design with industry based data has not yet been conducted. We showed that the analysis of the airline industry provides fruitful grounds to conduct such research. Such work has the potential to advance our understanding of the theory's implications in different practical settings.

Of course, this research has its limitations. First, it should be noted that we do not measure cognitive effort directly. Rather, we use the number of alternatives presented as a proxy for the effort required in finding the optimal date/price combination. Using this proxy, we suggest that when the number of options displayed is smaller, users would be less likely to find a low price alternative. As suggested in this paper, the reasons are quite intuitive – in order to access the same number of options, the users with limited display need to conduct more searches, and thus apply more effort, which, according to the cost-benefit model, they are reluctant to do. However, it is important to note that our analysis is based on theory built in previous work, and that we did not re-validate it in this paper. That is, we assume that since more cognitive effort is required to achieve the same outcome, users with "low-flexibility" displays would not examine the same number of options as users with "high-flexibility" displays do. Indeed, the theory and results align well with the cost-benefit model. However, perhaps other reasons for the effect of decision aids on pricing may be suggested.

Second, since this paper builds on industry based data, the variance in the number of alternatives displayed by the different carriers is limited, and ranges only between 7 and 49 alternatives. Therefore, one should be cautious when extending from these results to larger ranges of alternatives. In fact, it is reasonable that there exists a saturation point in which additional alternatives displayed would impose information overload and would not reduce cognitive effort.[5] At the same time, since the carriers' decision aids usually use special fonts and colors to highlight the alternatives with the lowest prices, it is reasonable that these results would hold for larger number of alternatives as well. Indeed, a promising venue for future research would be to examine the tipping point in which the contribution of additional alternatives displayed becomes insignificant.

Finally, our analysis is based on the notion that some online travelers purchase airline tickets directly from the carrier. This assumption may seem reasonable given loyalty programs and the notion that costs can be reduced when a disintermediated purchase is conducted. However, it should be noted that our analysis is equally valid even if customers often purchase from online travel agents. In fact, such a setting implies that the results of our study could have been more significant had more travelers purchased directly from the carriers.

This research raises interesting questions about the way companies design their websites. In our case, if one presentation format facilitates superior pricing mechanisms, why don't all the carriers adopt this format? Many explanations can be proposed. One explanation could be that other presentation formats impose advantages not relevant to pricing as investigated in our research (such may include technological considerations – i.e., better site maintenance, easier updates of data, etc). An equally appealing explanation is that some (or all) of the carriers are not aware of the impacts the different formats impose – the flexible format is supported only to provide similar functionality to the one available on competitor sites. We believe that a promising venue for future research would be to examine these issues as the different sites evolve.

Many other directions for future work can be derived from this research. For example, different aspects of a website display can be considered. Another venue for future research could be to examine how the decision aid support provided by a website effects the adoption of the website. These are only a few of the many possible opportunities for research associated with this work.

In conclusion, we believe that the empirical analysis conducted in this research can improve our understanding of processes originating from the interaction between online purchase decisions and pricing mechanisms. The research results presented in this manuscript are consistent with the idea that cognitive efforts affect decision outcomes, and that these can have important implications on demand and pricing realizations.

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[5] Generally, a good way to check for such an effect would be to incorporate additional polynomial variables of flexibility in the regression. However in our case, since the range is limited, the flexibility variable would be highly correlated with the introduced polynomial variables.

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