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The Quality – Profitability Link in the US Airline Business:
A Study Based on the Airline Quality Rating Index

Nicole Kalemba*, Fernando Campa-Planas

University Rovira and Virgili, Reus, Spain

Abstract

One of the key tasks of an airline company and management is to ensure a high standard of service quality to the customers. Therefore, the paper deals with the importance of the quality-profitability link in the air transportation business. Although there are several quality indexes in the airline business, we are focusing exclusively on the Airline Quality Rating Index (AQR). The AQR includes four main aspects in the measurement, namely on-time performance (OT), denied boardings (DB), mishandled baggage (MB) and customer complaints (CC). The results of this study show a significant effect of the AQR on the US airlines' profitability. On time performance, mishandled baggage and customers complaints also affect the profitability significantly, while a non-significant effect on profitability is given by the AQR component denied boardings. None of the previous researches took into account the link between the AQR index and the profitability of the US airlines. Therefore, this identified gap could encourage airline managers to invest more in quality and its related aspects, as far as the results confirm a significant impact on the airlines' profit.

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* Corresponding author.

E-mail address: nicole.kalemba@urv.cat

1. Introduction

The transportation industry and especially air transportation is one of the sectors that significantly contributes to the socio-economic development as well as to the growth and improvement of living standards [14]. The day-to-day challenge for airline companies is, among many other factors, to provide a high service quality to the customers and users of the airlines as well as to respond to the customers' requirements, what, in turn, leads to a higher passengers' satisfaction and has consequently an impact on their decision-making process [5, 12]. Starting with the deregulation in 1978 in the United States, major structural and management changes have been conducted and the issue of quality in this business got fundamental for reaching business excellence and a competitive advantage [1]. Another fundamental aspect is that customer perceptions and consequently service quality are influencing the positioning of the airlines [18]. As every interaction between airline and customer can have an impact on the image that the traveler can have in its mind, a successful market positioning strategy is necessary, contributing consequently to an increase of the companies' profitability [19]. Therefore, it is an interlinking of several factors that leads from service quality to profitability.

Obviously, it is imperative to take into consideration that service quality is mostly one of the main reasons and metrics by which the airline customers are judging the overall quality of an airline company [8]. But the question is, does this effort of trying to attract and retain customers through offering an adequate service quality really help to increment the profitability of the airline companies?

There has been already quite some focus from several researchers on the quality-profitability link in the airline business. Most of the results of previous studies set out that quality has a positive influence on profitability [10, 22] [17]. While the study carried out by Campa-Planas et al. [9] included 4 quality indexes applied in the US airline industry, namely the American Customer Satisfaction Index (ACSI), Airline Quality Rating (AQR), JD Power Airline Satisfaction Index and the Net Promoter Score (NPS); the current study aims to focus exclusively on the AQR, as it is the index with the most public detailed and precise methodology. Therefore, the present article contributes to previous works. First, because it generally offers an overview on how quality can be measured in the airline industry, and secondly, it analyzes a possible relationship between quality and profitability in the US airline industry, based on the Airline Quality Rating index.

The structure of this paper is as follows: We first describe the Airline Quality Rating (AQR) index with its methodology and origins, treating separately the factors the index is composed of. Secondly, we review the academic literature on researches that included the AQR index in their study. Subsequently, the method applied for this study is described and thereafter, results are shown. The final section gives an overview on the conclusions drawn from this study and discusses the potential limitations and further research.

2. The AQR rating – methodology and origins

The Airline Quality Rating (AQR) is a joint research project funded as part of faculty research activities at the Wichita State University and Embry-Riddle Aeronautical University since 2014. The Airline Quality Rating Reports were published through a joint research project between Purdue University and Wichita State University [24]. It is an index that is domestically and internationally accepted and acknowledged by the airline industry. It summarizes the quality ratings and permits to compare the performance of the domestic US airlines included in this ranking [3] [8] due to the focus on quantitative factors for providing a more certain result [5]. Being published annually and founded by Bowen and Headley, the ranking included in the first years since its creation in 1991 until 1998 a weighted average of 19 quality related factors. In 1999, Bowen and Headley simplified the index and focused exclusively on only 4 quality related aspects: on-time arrivals (OT), involuntary denied boardings (DB), mishandled baggage (MB) and customer complaints (CC) [3, 13].

The formula calculating the results for the AQR [24] score is as follows:

$$AQR = \frac{(+8.63 \cdot OT) + (-8.03 \cdot DB) + (-7.92 \cdot MB) + (-7.17 \cdot CC)}{(8.63 + 8.03 + 7.92 + 7.17)} \quad (1)$$

The closer to zero the result of the AQR, the better is the overall performance of an airline. Three of the four variables are weighted negatively, as those elements have a negative impact on the customers’ overall satisfaction. On one hand, the positive or negative sign of the formula for calculating the AQR depends on the impact and the perception the consumer gives to that element. Therefore, only on-time arrival is seen as a positive repercussion on airline quality, while denied boardings, mishandled baggage and customer complaints have a negative impact on the through customers perceived airline quality. On the other hand, the weighting shows the significance of each element in the customers’ decision making process, where on-time performance is weighted as the most important factor. Table 1 offers an overview on the 4 elements the AQR index is composed of, together with its weight and impact.

Table 1. Components of the AQR index: explanation, weight and impact.

Element	Explanation	Weight and impact
On-time performance (OT)	Referring to the flights that are within 15 minutes of the estimated time.	8.63 (+)
Involuntary denied boardings (DB)	Referring to the total number of passengers that have an involuntary denied boarding due to an overbooked flight. Reports are done per 10,000 passengers by carrier.	8.03 (-)
Mishandled baggage (MB)	Includes all the customer claims about damaged, delayed or lost baggage; reports are done per 1,000 passengers by carrier.	7.92 (-)
Customer complaints (CC)	Referring to 12 aspects, as for instance, terms as oversales, flight problems, reservation related complaints, ticketing, among others. Reports are done per 100,000 passengers by carrier.	7.17 (-)

Figure 1 shows the AQR US industry average performance during the years 1999–2015 calculated through the current applied formula. During the years 2000–2003 a slight improvement of the AQR index is given, decreasing afterwards until 2007, where the AQR index reaches its worst result (−2.16), consequence of the poor performance across the industry at that time. From 2008–2013 the industry performance increased significantly and reached in 2013 the best industry score of the history of the AQR (−1.07). Especially taking into account the difficult economic situation, this improvement shows the positive evolution of the airline industry. 2014 and 2015 show a slight decrease regarding 2013, but displaying a positive evolution.

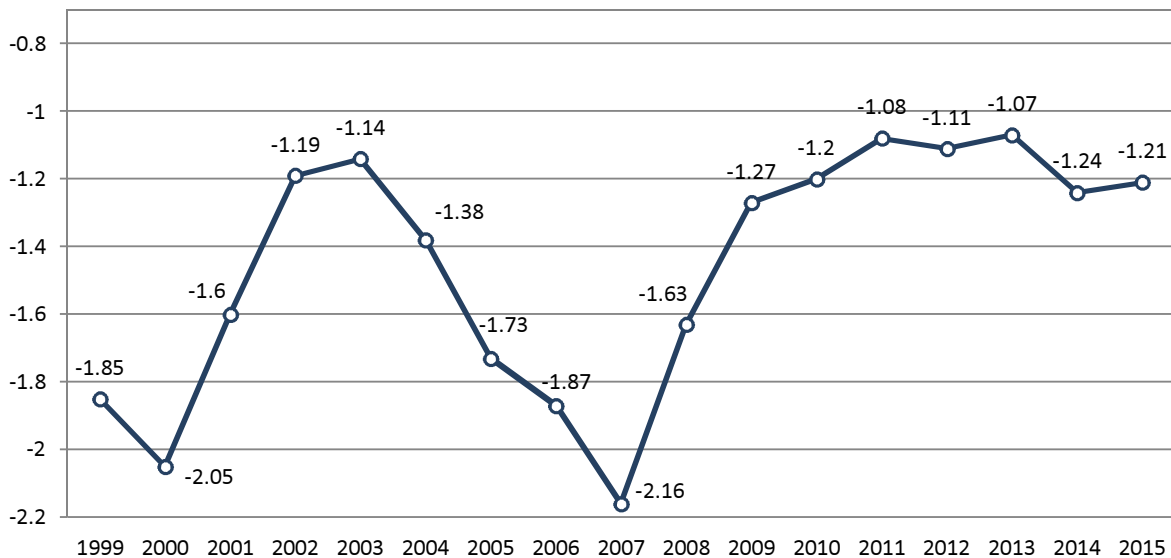


Fig. 1. AQR Industry Average Performance 1999–2015.

3. Literature review

A small number of authors considered the Airline Quality Rating index in their studies. A search has been carried out using two academic databases Web of Science [23] and Scopus [21] to detect published academic research studies – from 1991–2016 – that took into consideration the AQR. The aim of this review was identifying preliminary studies on the importance of the AQR as a quality measure in the airline business and its profitability link. Through the search, a total of 6 papers that met the mentioned conditions, were found. 2 of them were repeated in both databases Web of Science and Scopus. 4 of the 6 papers are written by the same authors, namely Bowen and Headley [5–8], founders of the AQR rating. Table 2 shows a summary of the 6 papers that have been found in the literature review.

Table 2. Literature review on the AQR index.

Authors (year)	Paper title (journal)	Issue
Bowen, Headley, Luedtke (1992)	A Quantitative Methodology for Measuring Airline Quality (Journal of Aviation/Aerospace Education & Research)	Importance of providing service quality to the consumers; first approach and application of the AQR index, taking considering 19 quality related factors.
Gradner (2004)	Dimensional Analysis of Airline Quality (Interfaces)	Dimensional analysis for ranking the airlines in their overall quality, giving a broad overview on the AQR index.
Bowen, Headley, Lu (2004)	Developing a Standardized Mechanism for Measuring Airline Service Performance: A Preparation for Airlines and the Flying Public (International Journal of Applied Aviation Studies)	Explains the development and measurement of the AQR index and outlines the importance of benchmarking procedures.
Bowen, Scarpellini-Metz, Headley (2005)	Understanding Consumer Preference-Findings from the Airline Survey (International Journal of Applied Aviation Studies)	Study about consumer preferences of frequent fliers and their perceptions, taking into account the AQR index. Additionally, price and schedule are seen as essential airline service elements.
Gursoy, Chen, Kim (2005)	The US Airlines relative positioning based on attributes of service quality (Tourism Management)	Study about the importance of the positioning of different US airline companies, referring to aspects that are related and included in the AQR.
Bowen, Bowen, Headley, Küçükönal, Wildt (2013)	An innovative leadership effectiveness measure: Applied analytic indicators of high-consequence industry performance (Procedia-Social and Behavioral Sciences)	The authors created an airline performance formula to see that the applied methodology of the AQR provides an important tool for assessing organizational leadership.

All of the studies include the AQR index as an important tool, explaining its development and measurement, but in none of the papers it has been established any relationship between quality and the profitability of the airline companies. This identified gap has been used to study the relationship between the quality related components of the AQR index and the profitability of the US airlines, measured through the Return on Investment (ROI).

4. Method

This section aims to describe the method used in this study, to show the data collection and sample, as well as to explain the measures and data analysis that have been carried out.

4.1. Data collection and sample

The study considers sources of information as the Airline Data Project (ADP) developed by the Massachusetts Institute of Technology (MIT) [15] for the airline related Key Performance Indicators (KPIs) and financial data. On the other hand, publicly available data of the AQR index is extracted from the annually published reports developed by Bowen and Headley [3, 4]. Longitudinal time-series data for the years 2000–2015 has been taken into consideration; the sample collection was comprised of a total of 13 US airline companies, for the years where data

were available, namely Air Tran, Alaska, American, American West, Continental, Delta, Frontier, Hawaiian, Jet Blue, Northwest, Southwest, United and U.S. Airways.

4.2. Measures and data analysis

One generic statistical model and 4 specific sub models have been established, including in each of them dependent, explanatory and control variables. As dependent variable, we used Return on Investment (ROI); it measures the US airline companies’ profitability and gives an idea on the evolution of the business performance, without considering the financial structure.

As explanatory variable, we included quality. On one hand, the total AQR index for the generic model (H1), seeing if quality, based on this index, affects significantly the profitability of the US airlines. And, on the other hand, for the four specific sub models we disassembled the AQR, creating one sub model for each of the four quality factors (H2–H5), for getting an overview on the impact that each of the factors has (or not) on the US airlines’ profitability.

Therefore, the hypotheses are as follows:

- H1: Quality, measured through the AQR affects significantly the US airlines’ profitability;
- H2: On-time arrival (OT) has a significant impact on US airlines’ profitability;
- H3: Denied boardings (DB) have a significant influence on the profitability of the US airlines;
- H4: Mishandled baggage (MB) impacts significantly the profitability of the US airlines;
- H5: Customer complaints (CC) affect significantly the US airlines’ profitability.

The conceptual model is shown in Fig. 2.

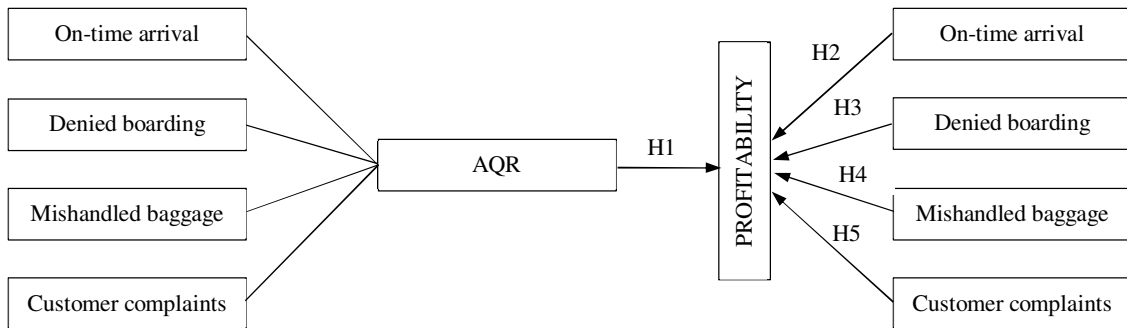


Fig. 2. Conceptual model and hypotheses.

Finally, as control variables we included in all models first the passenger load factor (LF), being the relationship between revenue per miles (RPM) and available seat miles (ASM), as well as the logarithmic number of total employees (LOGempl) of the airlines.

For this study, a panel data approach with regression models for longitudinal data [11] was used to estimate the relationship within the US airline industries’ profitability and the effects of quality on those.

5. Results

Both, descriptive statistics in Table 3 and the correlation matrix (table 4) are considering the dependent, explanatory and control variables that are included in the estimation models. All the analysis for this study have been carried out using the statistical programming language R, version 3.3.2 [20].

Table 3. Descriptive statistics.

Variables	Min	Max	Mean	sd
ROI	-0.280	0.273	0.016	0.086
AQR	-3.430	-0.400	-1.252	0.542
OT	0.614	0.938	0.790	0.056
DB	0.010	2.470	0.8145	0.535
MB	1.580	9.620	3.870	1.430
CC	0.140	7.860	1.315	1.111
LOGempl	6.541	11.502	9.852	1.152
LOGpax	7.028	11.897	10.379	1.020
LF	0.579	0.907	0.787	0.060

Table 4. Correlation matrix.

Variables	ROI	AQR	OT	DB	MB	CC	LOGempl	LOGpax	LF
ROI	1								
AQR	.266	1							
OT	.230	.603	1						
DB	-.096	-.588	-.238	1					
MB	-.250	-.882	-.546	.417	1				
CC	-.190	-.667	-.403	.164	.314	1			
LOGempl	-.204	-.429	-.235	.340	.309	.340	1		
LOGpax	-.089	-.324	-.208	.298	.261	.186	.942	1	
LF	.329	.262	.243	-.156	-.250	-.124	-.076	-.051	1

The correlation matrix in Table 4 reports a high correlation between both company size variables that have been included at the beginning, LOGempl and the logarithmic number of total passengers (LOGpax) (.942). Consequently, we suggested to include only one company size variable, in this case employees, for avoiding any biased effects by the multicollinearity. For carrying out the statistical analysis, a panel data methodology has been executed with longitudinal time-series data from 2000–2015, where we established one generic estimation model for the AQR index and four estimation sub models for each of the four components of the AQR index, using the same specification model that is as follows:

$$ROI_{it} = \beta_{1x} Quality_{it-1} + \beta_{2x} Load\ factor_{it} + \beta_{3x} Size_{it} + \varepsilon_{it} \quad (2)$$

We considered to look at quality data $it - 1$ as we suggest that the service quality provided to the consumers does not affect the profitability of the same year of an airline company, but we guess that it can have a positive repercussion on profitability after at least one year. The models in Tables 5 and 6 are reporting beta weights and t-values as well as F tests and Hausman-type test that have been conducted.

The generic estimation model 1 shows a significant effect for quality on airlines' profitability measured through the AQR index ($\beta_1 = .059$; $p < 0.001$), reason why hypothesis 1 is supported.

Additionally, the effects of the control variable load factor are significant with a positive sign of the coefficient ($\beta_1 = .379$; $p < 0.01$), demonstrating the influence of the load factor on the airlines' ROI, while a non-significant effect is shown for the size variable, measured through the variable LOGempl.

Table 5. Generic estimation model 1.

Variables	Model 1 (AQR)	
	Dependent variable: ROI	
	β_1	T
Intercept	-.206*	-1.771
Quality(AQR) _{it-1}	.059***	5.310
Load factor _{it}	.379**	3.224
Size (LOGempl) _{it}	-.000	-.014
Hausman test (fix vs random)	156.06***	
Adjusted R ²	0.271	
F	18.971***	

All coefficients are standardized beta weights and t-values are also given.
 ***p < 0.001; **p < 0.01; *p < 0.05; +p < 0.1.

Table 6. Estimation sub models 1 and 2.

Variables	Sub model 1 (On-time arrival)		Sub Model 2 (Denied boardings)		
	Dependent variable: ROI		Dependent variable: ROI		
	β_{1_1}	t	β_{1_2}	t	
Intercept	-.176	-1.472	Intercept	-.244 ⁺	-1.920
Quality(OTest) _{it-1}	.029***	4.623	Quality(DBest) _{it-1}	-.002	-.310
Load factor _{it}	.349**	2.849	Load factor _{it}	.519	4.103
Size (LOGempl) _{it}	-.008	-1.186	Size (LOGempl) _{it}	-.015	-1.961
Hausman test (fix vs random)	14.404**		Hausman test (fix vs random)	14.382**	
Adjusted R ²	0.241		Adjusted R ²	0.127	
F	16.314***		F	8.025***	

All coefficients are standardized beta weights and t-values are also given.
 ***p < 0.001; **p < 0.01; *p < 0.05; +p < 0.1.

Table 7. Estimation sub models 3 and 4.

Variables	Sub model 3 (Mishandled baggage)		Sub Model 4 (Customer complaints)		
	Dependent variable: ROI		Dependent variable: ROI		
	β_{1_3}	t	β_{1_4}	t	
Intercept	-.235 ⁺	-1.972	Intercept	-.246*	-2.100
Quality(MBest) _{it-1}	-.030***	-4.395	Quality(CBest) _{it-1}	-.035***	-5.064
Load factor _{it}	.397**	3.287	Load factor _{it}	.387**	3.271
Size (LOGempl) _{it}	-.006	-.805	Size (LOGempl) _{it}	-.004	-.619
Hausman test (fix vs random)	18.16***		Hausman test (fix vs random)	32.298***	
Adjusted R ²	0.231		Adjusted R ²	0.260	
F	15.514***		F	17.979***	

All coefficients are standardized beta weights and t-values are also given.
 ***p < 0.001; **p < 0.01; *p < 0.05; +p < 0.1.

Tables 6 and 7 report the four estimation sub models, where the quality components have been used as standardized variables. The sub models 1, 3 and 4 show a similar effect on the airlines' profitability as the generic

model 1. Therefore, 3 out of the 4 quality elements that compound the AQR index, show a significant effect on profitability ($\beta_{11} = .029$; $\beta_{13} = -.030$; $\beta_{14} = -.035$; $p < 0.001$), namely on-time performance, mishandled baggage and customer complaints (supporting H2, H3 and H5). On-time performance (sub model 1) is the only AQR element that positively affects the profitability of the airline companies, having therefore a positive sign.

Having a look on the AQR index, on-time performance is the most significant element on profitability, showing a positive correlation. This, in turn, matches with the researches of other authors [2, 16] that considered that on-time performance is directly linked to profitability in the US airline industry, as it helps to reduce and save costs, as well as time that is needed for rescheduling flights. Likewise, similar to the generic model of the AQR, the mentioned three sub models show a significant effect of the control variable load factor on profitability ($\beta_{21} = .349$; $\beta_{23} = .397$; $\beta_{24} = .387$; $p < 0.01$), demonstrating the influence of the load factor on the airlines' ROI. A non-significant effect is shown for the size variable in all the three sub models, measured through the logarithm of employees. Contrary to this, H3 is not supported, as denied boardings do not show any significant effect on airlines' profitability.

However, it is necessary to mention the limited value of the adjusted R^2 for the sub models 1, 3 and 4 (0.242; 0.231 and 0.260, respectively) that suggests the inclusion of other variables that can affect the airlines' ROI.

6. Conclusions and discussion

The purpose of this study was to provide an idea on the quality-profitability link in the US airline industry, basing the research on the AQR index, a helpful and effective quantitative and comparable tool that offers the possibility to benchmark data between US domestic airlines.

Results show consistency with our hypotheses, where quality (AQR) affects significantly the profitability (ROI) of the airlines. At the same time, considering the components of the AQR, a positive correlation between on-time performance and profitability is shown (positive impact), as well as a significant effect of mishandled baggage and customer complaints on profitability (negative impact). While the influence of denied boardings on profitability is insignificant. This outcome can encourage airline managers to focus on an improvement of the overall quality provided to the customers, as it can lead to a higher satisfaction and loyalty, emphasizing specifically the importance and continuation of on-time performance, but also focusing on the reduction of mishandled baggage and customer complaints, as it has a negative outcome on the profitability of airline companies. Thus, in today's highly competitive airline industry environment, it is essential that the airline companies do their best effort to attract and retain their customers, as well as to differentiate themselves from the competitors through offering an adequate standard of service quality for consequently reaching a higher profitability.

This study has some restrictions and limitations, as the AQR index only includes the US airline market. Therefore, it would be interesting to study also European airline companies for being able to compare their standard of quality and the impact on profitability.

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