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Measuring airport service quality: A multidimensional approach

George Christian Linhares Bezerra [a,*], Carlos F. Gomes [b]

[a] University of Coimbra, School of Economics, Av. Dias da Silva, 165, Coimbra, Postal Code 3004-512, Portugal
[b] University of Coimbra, School of Economics, ISR – Institute of System and Robotics, Av. Dias da Silva, 165, Coimbra, Postal Code 3004-512, Portugal

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ABSTRACT

Currently, airports are expected to be operated as self-sufficient service organizations providing efficient and high-quality services to a variety of customers. In this context, improving airport service quality (ASQ) has become paramount. However, due to the complexity of the airport service environment, an effective process of measuring and analyzing passenger perceptions of ASQ is not easily achieved. Generic scales for perceived service quality might not cover some particularities of the passenger–airport interaction. Furthermore, while some measurement practices have been developed within the airport industry, there has been only limited consideration for validity and reliability. These concerns are certainly relevant to avoid misinterpreting passenger perceptions. In view of these concerns, this paper has a twofold objective. First, to fit a measurement model for perceived ASQ built on typical service measures within the airport industry. Second, to test for the model's equivalence across groups of passengers. Sample data from an extensive survey applied at a major Brazilian airport was used for confirmatory factor analysis. The results suggested that a six-factor structure provides a meaningful multi-item measurement model for perceived ASQ. The model was validated for international and domestic departing passengers with respect to its factorial structure and metric invariance. The proposed measurement model could be considered an alternative for a multidimensional approach in the context of airport performance measurement regarding service quality. Finally, the findings from this research might contribute to the discussion on passenger perceptions of ASQ, particularly concerning its multidimensionality and the need to review current practices for ASQ analysis.

1. Introduction

As traffic volume rises, airports struggle to optimize infrastructure while adopting a customer-oriented focus to achieve better performance (Fodness and Murray, 2007; Halpern and Graham, 2013). Also, non-aeronautical revenues have become critical for airport sustainability, which leads to increasing concerns with the marketing of retail areas within airport terminals (Gillen, 2011). Therefore, the relevance of understanding passenger perceptions of airport service quality (ASQ) is paramount.

Within the airport industry, service quality measures based on passenger perception have typically been used for operational performance measurement and benchmarking purposes. Moreover, regulators and governments habitually use service quality monitoring to assure that the interests of airport users are not being compromised (Francis et al., 2002). With the growing interest in the subject, ASQ surveys have been systematically carried out by international agencies, regulatory authorities, airport operators, and other organizations (ACI, 2014; Fodness and Murray, 2007; IATA, 2015; Kramer et al., 2013; Zidarova and Zografos, 2011).

More recently, some approaches and methods usually applied within other industries appear to have gained momentum. For instance, analysis of passenger expectations regarding the airport service and using a structural equation modeling approach to the complex relationships between passenger attitudes and ASQ (Bogicevic et al., 2013; Fodness and Murray, 2007; Jeon and Kim, 2012; Nesset and Helgesen, 2014; Park and Jung, 2011). It seems that there is increasing interest in understanding ASQ multidimensionality and the multifaceted nature of the passenger–airport interaction.

Nevertheless, due to the complexity of the airport service environment, an effective process for measuring and analyzing relevant information regarding passenger perceptions of ASQ is not a simple achievement. Generic service quality measurement

* Corresponding author.
E-mail addresses: george.bezerra@student.fe.uc.pt (G.C.L. Bezerra), cfgomes@fe.uc.pt (C.F. Gomes).

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approaches might not be able to cover the more particular aspects of the passenger's interaction with airport services and facilities (George et al., 2013; Pantouvakis, 2010). Furthermore, current practices within the airport industry have usually been based on the service attribute level, with none or only limited consideration for the validity and reliability of the measurement instruments.

In this context, the objective of this paper is twofold. First, to fit a measurement model for perceived ASQ based on typical service quality measures within the airport industry. Second, to test for the equivalence of the proposed model across groups of passengers. This present paper is part of an extensive research project that considers the multidimensionality of ASQ and its monitoring in the context of airport performance measurement. The relevance of these objectives is related to avoiding misinterpretation of the results taken from service quality surveys within the performance measurement process.

Sample data from a survey applied to departing passengers at Guarulhos International Airport, in Brazil, was used. Confirmatory factor analysis was used to test for the factorial validity of an ASQ framework, based on a previous exploratory study by Bezerra and Gomes (2015), and for model specification. Afterwards, the invariance of the measurement instrument was tested across groups of international and domestic departing passengers.

In the next section, a background on ASQ is provided, including the evolution of the literature research and current challenges. In the methods section, the sample characteristics, data collection, research procedures, models, and variables are described. Results and discussions on the findings are subsequently provided. Finally, the concluding remarks section outlines the contributions of this research effort and considerations for future research.

2. Background

Airport Service Quality (ASQ) has become a regular topic within the airport-related literature. Nonetheless, until the 1980s there were few studies related to the subject, typically concerned with assessing the level of service in the passenger terminal (e.g. Bennets et al., 1975; Mumayiz and Ashford, 1986; Omer and Khan, 1988; Tosic and Babic, 1984). Later, in the 1990s, some studies focused on understanding passengers' needs and their perceptions regarding elements of the passenger terminal and airport-related processes (e.g. Hackett and Foxall, 1997; Lemer, 1992; Muller and Gosling, 1991; Mumayiz, 1991; Park, 1999; Seneviratne and Martel, 1991, 1994; Yen, 1995).

Regarding the service industry as a whole, in a constantly changing business environment, understanding customer perception of quality became critical. As the perceived level of quality is an antecedent of customer satisfaction with the service performance, measuring service quality using customer-based variables may guide the organization's efforts to better deal with customer needs (Cronin et al., 2000; Falk et al., 2010; Wilson et al., 2012).

In this context, the airport industry has been progressively motivated to adopt a different approach regarding ASQ. More recently, the literature expanded in terms of quantity and the range of issues covered. Hence, a broader approach to ASQ based on passenger perception became more evident, including:

a. Further investigation on passenger perception of quality and his/her level of satisfaction with different airport service attributes. Some studies based on econometric approaches (e.g. Correia et al., 2008a; Correia and Wirasinghe, 2007; De Barros et al., 2007; Eboli and Mazzulla, 2009; Gkritza et al., 2006), and others based on Multi-Criteria Decision Analysis (MCDA) tools (e.g. Chien-Chang, 2012; Kuo and Liang, 2011; Lupo, 2015; Tsai et al., 2011; Yeh and Kuo, 2003);
b. Resuming investigation on passenger expectations regarding airport services (Bogicevic et al., 2013; Caves and Pickard, 2000; Chang and Chen, 2011, 2012; Fodness and Murray, 2007; George et al., 2013; Rhoades et al., 2000);
c. The nature of the effects of different service attributes on passenger satisfaction with the airport (Bogicevic et al., 2013; Mikulic and Prebežac, 2008; Prebezac et al., 2010);
d. Discussions on service quality measurement, including exploratory studies on the ASQ multidimensionality (Bezerra and Gomes, 2015; Fodness and Murray, 2007; George et al., 2013);
e. Taking into account for service quality within studies on airport efficiency measurement (De Nicola et al., 2013; Merkert and Assaf, 2015).

Also, there is a growing interest in the structural equation modeling (SEM) approach to account for the complex relationships among the various aspects of service quality and passenger attitude (Fodness and Murray, 2007; Jen et al., 2013; Jeon and Kim, 2012; Lubbe et al., 2011; Nesset and Helgesen, 2014; Park and Jung, 2011). It appears that a more comprehensive approach to understanding the multidimensionality of ASQ and the multifaceted nature of the passenger–airport interaction has been pursued.

Due to the complexity of airport settings, however, generic scales for measuring perceived service quality may not be able to cover some specific features related to airport services and facilities (George et al., 2013; Pantouvakis, 2010). Based on a functional approach, a passenger terminal system comprises three major areas: access interface, processing area, and flight interface (Horonjeff et al., 2010). The processing area, the focus of the present study, comprises every space where the passenger is processed in any activity related to the starting, ending, or continuation of the trip (e.g. ticketing, check-in, security inspection, etc.).

According to the passenger point of view, two main categories of activities in the airport terminal may be considered: process activities and discretionary activities (Popovic et al., 2009; Caves and Pickard, 2000). In the case of departing passengers, process activities comprise the passenger flow from check-in, security screening, until boarding. Discretionary activities comprise what the passengers are able to do with their slack time in the terminal (i.e. those moments when they are moving between processing points), when they can shop, eat, rest, change money, or engage in any other activity provided by the airport.

With respect to processing activities, passenger perception of quality has been traditionally associated with the efficiency of the processes, short waiting times, and the positive attitude of the service staff (Caves and Pickard, 2000; Fodness and Murray, 2007; Rhoades et al., 2000). As to discretionary activities, a variety of factors should be considered, including passenger perception of leisure/convenience alternatives and airport servicescape, i.e., the physical setting in which a service is performed, delivered, and consumed (Bitner, 1992; Bogicevic et al., 2013; Mari and Poggesi, 2011).

Regarding the current ASQ measurement practices, the literature review undertaken in this study revealed a focus on analysis at the service-attribute level, with data collection based on surveys. Common measures include items related to the efficiency of specific services or processes, signage and cleanliness of terminal areas, attitude of the staff, and availability of convenience facilities, among several others. Additionally, as an elaborate servicescape, an airport comprises a complex service environment, in which visual appeal, functionality, and comfort can affect passenger perception of service quality. The effects of airport physical surroundings on passengers' perceptions of ASQ has been more recently discussed (Fodness and Murray, 2007; Jen et al., 2013; Jeon and Kim, 2012; Bogicevic et al., 2013).

In spite of systematic practices within the airport industry (ACI, 2014; IATA, 2015; Kramer et al., 2013; Zidarova and Zografos, 2011), they have usually been more concerned with context-specific purposes. Thus, considerations on the reliability and validity aspects of the measurement instrument have received only limited attention (George et al., 2013).

Overall, it seems that there is an increasing acknowledgment of the multidimensionality of ASQ. In fact, some studies previously mentioned have stressed passenger perception according to a multidimensional approach, and some factorial structures for measuring ASQ have been discussed. However, there is still a need for further investigation on the validity and reliability of service quality measurement in the airport setting. The relevance of such concerns is paramount in avoiding misinterpretation of passenger perceptions and guiding the use of surveys within the performance measurement process.

3. Methods

3.1. Sample and data collection

Data was obtained from a survey applied to passengers at Guarulhos International Airport, in Brazil. Data collection comprised the period from January to December of 2014. Passengers were approached at the departure lounges during airport peak hours so that to gather their opinions at a moment of high demand (SAC, 2015). Moreover, contacting passengers at the departure lounge assures that they have already had the opportunity to experience the services, processes, and facilities.

A total of 2485 forms were collected from departing passengers. As sample size was large enough to proceed with the proposed multivariate techniques, missing value treatment was listwise exclusion (Byrne, 2010; Hair et al., 2009). Therefore, the useful sample comprised 1155 observations, 762 passengers of international flights and 393 passengers departing on domestic flights.

The sample of international passengers was used for testing for factorial validity and model specification. The sample of domestic passengers was used for testing for the equivalence of the measurement model. The relevance of this approach relies on the fact that international and domestic passengers may present different interaction and behavioral patterns during their experience with the airport.

Normality was assessed based on the Skewness and Kurtosis coefficients. The Mahalanobis' distance squared was used for outlier identification (Byrne, 2010). Accordingly, 40 observations were excluded from the sample of international passengers. The sample characteristics are presented in Appendix A.

As regards the research instrument, the original set of measurement items comprised typical attributes related to services/processes performance and airport terminal facilities. The items are aligned with industry best practice guidelines (ACI, 2014; IATA, 2015) and they are similar to several research studies (e.g. Correia et al., 2008b; Kramer et al., 2013; Park and Jung, 2011; Yeh and Kuo, 2003). Passengers indicated their opinion by rating on a five-point scale.

This present study focused on those aspects directly or indirectly related to the airport management regarding the passenger terminal, as previously considered by Bezerra and Gomes (2015). Table 1 presents the descriptive statistics for the measurement items.

3.2. Models, variables and data analysis

Bezerra and Gomes (2015) used exploratory factor analysis (EFA) to extract service quality factors from a set of typical attributes within the airport industry. The authors used responses of international departing passengers at Guarulhos International Airport, in Brazil. A proposed ASQ framework comprising seven factors representative of the passenger perception of the airport services and facilities was provided.

In the present paper, the factorial validity of this ASQ framework was tested using a new sample of international departing passengers from the same airport. Table 2 summarizes the variables and respective service quality factors, along with the Cronbach's alpha values for each factor and other results supporting factor unidimensionality obtained from EFA.

Sample data was assessed on the existence of common method bias using the Harman's single factor test and the common latent factor approach (Podsakoff et al., 2003). Based on the tests, there was no indication of significant concerns regarding common method variance.

Provided with these results, CFA models were estimated with the software IBM AMOS, version 21. The 23 observed variables were assumed to load only on their respective factors. The seven factors were assumed to be intercorrelated, while the measurement errors of the observed variables to be uncorrelated. The models were estimated by the maximum likelihood method (Byrne, 2010). Validity and reliability were assessed according to Fornell and Larcker (1981). Models' goodness of fit was evaluated based on references of Byrne (2010) and Hair et al. (2009).

4. Results and discussion

4.1. Testing for the factorial validity and model specification

Overall, a first model revealed an acceptable goodness-of-fit (CMIN/df = 4.688; GFI = 0.889, PGFI = 0.673, CFI = 0.941, PCFI = 0.778; RMSEA = 0.072). All the regression weights presented positive signs and statistical significance ($p\text{-value} < 0.001$ level).

However, examining the items reliability, the variable CHK3 (Availability of luggage carts) presented a low value for squared multiple correlation. Only about 25% of its variance was explained by the factor Check-in. In addition, its standardized regression weight was much lower (0.501) comparing with the other variables reflecting the factor (>0.800). Along with the item-total correlation presented in Table 3, these results indicated the exclusion of this variable and may suggest that passengers do not perceive the availability of luggage carts necessarily related to the quality of the check-in process.

As regards construct validity and reliability, there were significant concerns related to the factor Prices. The composite reliability (CR = 0.65) and the average variance extracted (AVE = 0.482) indicated reliability and convergent validity issues. The square root of the AVE was less than the correlation with the factor Convenience ($r = 0.848$), which is indicative of no sufficient discriminant validity for this factor.

Customers usually evaluate prices based on their perception of value as regards the service performed (Cronin et al., 2000; Gordon and Levesque, 2000; Ravald and Grönroos, 1996), which may explain the strong correlation and the lacking of discriminant validity. These results support the idea that passenger perception of the prices practiced in the retail area should be considered as a different construct in a customer satisfaction model (i.e. perceived value) (Anderson and Fornell, 2000; Chen, 2008).

In view of these results and the theoretical and practical issues associated, we have concluded for misspecification of this initial model. Therefore, factor Prices and variable CHK3 were excluded for the following analyzes. Subsequently, a second model presented goodness-of-fit improvement (CMIN/df = 4.539; GFI = 0.907, PGFI = 0.669, CFI = 0.955, PCFI = 0.779; RMSEA = 0.070).

Table 1
Measurement items descriptive.

Variables	International passengers			Domestic passengers		
	Mean	SE	SD	Mean	SE	SD
Courtesy and helpfulness of check-in staff	3.53	0.039	1.043	4.13	0.047	0.923
Check-in process efficiency	3.55	0.036	0.976	4.11	0.044	0.874
Availability of luggage carts	3.16	0.053	1.416	4.14	0.065	1.073
Wait time at check-in	3.46	0.039	1.061	3.88	0.050	0.988
Feeling of being safe and secure	3.43	0.034	0.910	3.87	0.045	0.895
Courtesy and helpfulness of security staff	3.57	0.032	0.871	4.07	0.040	0.802
Thoroughness of security screening	3.54	0.034	0.913	3.96	0.043	0.852
Wait-time at security checkpoints	3.56	0.034	0.909	4.05	0.042	0.834
Courtesy and helpfulness of airport staff*	3.37	0.039	1.055	4.10	0.044	0.848
Availability and quality of stores	2.84	0.041	1.110	3.45	0.058	1.144
Availability of Banks/ATM/Exchange	2.85	0.040	1.076	3.62	0.055	1.094
Availability and quality of food facilities	2.55	0.044	1.176	3.45	0.058	1.144
Cleanliness of airport facilities	3.13	0.032	0.857	3.95	0.042	0.835
Thermal comfort	3.16	0.033	0.898	3.86	0.044	0.879
Acoustic comfort	3.10	0.034	0.927	3.82	0.046	0.918
Cleanliness of washroom/toilets	3.06	0.044	1.173	3.79	0.052	1.040
Availability of washroom/toilets	3.11	0.044	1.195	3.86	0.053	1.045
Departure lounge comfort	3.02	0.041	1.111	3.58	0.055	1.097
Walking distance inside terminal	3.27	0.037	0.986	3.67	0.052	1.027
Wayfinding	3.36	0.034	0.908	3.84	0.048	0.947
Flight information	3.36	0.036	0.962	3.81	0.047	0.934
Prices at food facilities	1.87	0.036	0.960	2.37	0.063	1.251
Prices at stores	2.35	0.041	1.110	2.56	0.064	1.233

Notes: SE – Standard error; SD – Standard deviation; *excluding check-in and security staff.

Table 2
EFA results for international departing passengers.

Factors and observed variables	α	α if item deleted	Item-total correlation	KMO	% variance extracted
CHK – Check in	0.873			0.767	73.403
CHK1 – Courtesy and helpfulness of check-in staff		0.765	0.801		
CHK2 – Check-in process efficiency		0.761	0.828		
CHK3 – Availability of luggage carts		0.922	0.497		
CHK4 – Wait-time at check-in		0.791	0.737		
SEC – Security	0.931			0.844	83.009
SEC1 – Feeling of being safe and secure		0.920	0.812		
SEC2 – Courtesy and helpfulness of security staff		0.927	0.787		
SEC3 – Thoroughness of security screening		0.896	0.883		
SEC4- Wait-time at security checkpoints		0.899	0.876		
CON – Convenience	0.840			0.725	67.862
CON1 – Courtesy and helpfulness of airport staff		0.850	0.546		
CON2 – Availability and quality of stores		0.762	0.752		
CON3 – Availability of Banks/ATM/Exchange		0.778	0.720		
CON4 – Availability and quality of food facilities		0.793	0.684		
AMB – Ambience	0.865			0.677	78.982
AMB1 – Cleanliness of airport facilities		0.911	0.629		
AMB2 – Thermal comfort		0.730	0.831		
AMB3 – Acoustic comfort		0.773	0.786		
BAS – Basic Facilities	0.933			0.763	88.230
BAS1- Cleanliness of washroom/toilets		0.886	0.883		
BAS2 – Availability of washroom/toilets		0.912	0.850		
BAS3 – Departure lounge comfort		0.909	0.855		
MOB – Mobility	0.909			0.715	84.652
MOB1 – Walking distance inside terminal		0.855	0.836		
MOB2 – Wayfinding		0.927	0.746		
MOB3 – Flight information		0.817	0.879		
PRC – Price	0.650			0.500	74.051
PRC1 – Prices at food facilities		NA	0.481		
PRC2 – Prices at stores		NA	0.481		

Note: a. α – Cronbach's Alpha; b. Bartlett's tests of sphericity with statistical significance <0.001 for all factors; c. NA – Not applicable.

Additionally, no validity or reliability issues were identified.

For the purpose of measurement model specification, we examined the standardized residual covariance (SRC). The only concern was variable CON1, with 15 out of 20 residuals higher than the threshold of 2.58 (Byrne, 2010). Moreover, the modification indices indicated that this variable might present significant cross-loadings to the other five factors.

Passengers' opinion about staff attitude (in this case, excluding check-in and security processes) is certainly important for understanding their perception of ASQ. However, it seems that item wording may not be sufficiently discriminant and passengers should have led to considering different groups of staff, such as retail stores, food facilities, information desks, etc. Hence, we decided for excluding this variable and no significant SRC or

Table 3
Pearson's coefficient of correlations, Cronbach's Alpha, and Factorial validity and reliability.

	CHK	SEC	MOB	AMB	BAS	CON	α	CR	AVE
Check-in – CHK	0.901						0.922	0.928	0.811
Security – SEC	0.494*	0.882					0.931	0.933	0.778
Mobility – MOB	0.346*	0.569*	0.884				0.909	0.914	0.782
Ambience – AMB	0.281*	0.460*	0.446*	0.842			0.865	0.877	0.708
Basic facilities – BAS	0.060	0.332*	0.355*	0.629*	0.908		0.933	0.934	0.825
Convenience – CON	0.240*	0.404*	0.372*	0.531*	0.583*	0.828	0.850	0.865	0.686

Notes: In the diagonal values for the square root of the AVE; *Significance level <0.001 for the correlations; α – Cronbach's Alpha; CR – Composite Reliability; AVE – Average Extracted Variance.

modification indices remained.

A six-factor model excluding factor Prices and variables CHK3 and CON1 presented a better factor structure and goodness-of-fit. Hence, there was no justification for any further model fitting (CMIN/df = 3.607; RMSEA = 0.060; GFI = 0.932; PGFI = 0.672; CFI = 0.969; PCFI = 0.777). The expected cross-validation index for maximum likelihood estimation (MECVI) was much smaller than the initial model (0.837 vs 1.551). The item reliability was confirmed by the squared multiple correlations (all above 0.40). Factorial validity and reliability were assured (Table 3).

4.2. ASQ measurement model

Fig. 1 presents the model structure along with the output for the sample of international departing passengers, including the standardized estimates for the regression weights and correlations. The relationships among the observed variables and the respective factors were statistically significant (p-value<0.001). The standardized estimates were reasonably high.

This six-factor model covers relevant issues related to the airport services and facilities, as perceived by the passengers, and may provide a comprehensive approach to the service quality measurement in the airport context. A brief description of the ASQ factors is provided in Appendix B.

After these procedures, the equivalence of this factor structure and its metric invariance across groups of international and domestic passengers were tested. Testing for the equivalence or invariance is needed to examine the suitability of the model for different groups of passengers.

4.3. Testing for the equivalence of the measurement model

A CFA model consistent with Fig. 1 was estimated with the sample of domestic departing passengers. The results indicated good fit (CMIN/df = 2.197; RMSEA = 0.055; GFI = 0.926; PGFI = 0.668; CFI = 0.960; PCFI = 0.769). Regression weights and covariances were statistically significant. Item reliability was confirmed by the squared multiple correlations. No validity or reliability concerns were identified.

The standardized regression weights and correlations estimated with this model are presented in Appendix C, along with the respective values for international passengers (Tables C.1 and C.2).

Provided with these results, the baseline model for both groups were assumed the same and configural invariance was assessed. The configural model presented good fit (CMIN/df = 2.092; RMSEA = 0.041; GFI = 0.930; PGFI = 0.671; CFI = 0.967; PCFI = 0.775). Hence, the factor structure was considered equivalent across groups, i.e. the measurement items were properly explained for their respective factors, whether the respondent is an international or domestic passenger.

Afterwards, the metric invariance was tested. Domestic and international departing passengers served as distinct groups for multi-group analysis based on the comparison of that configural model (unconstrained) and two constrained models:

Model 1 The factor loadings constrained to be equal.
Model 2 Both factor loadings and covariances among factors constrained to be equal.

In testing for metric invariance, two approaches were followed. The χ^2 difference between the comparing models ($\Delta\chi^2$), and the difference in the CFI (ΔCFI). The former is considered to be excessively stringent while the latter is reported to make more practical sense (Byrne, 2010; Cheung and Rensvold, 2002). The values for χ^2 (CMIN) and CFI for the three models are presented in Table 4.

The differences between model 1 and the unconstrained model were $\Delta\chi^2(13) = 54.112$ (p-value<0.001) and ΔCFI = 0.003. As regards model 2, $\Delta\chi^2(28) = 85.601$ (p-value<0.001) and ΔCFI = 0.004. Based on the ΔCFI tests, these results suggest invariance across the groups of international and domestic passengers (Cheung and Rensvold, 2002). However, with the $\Delta\chi^2$ being statistically significant, we focused on identifying which parameters could have been contributing to the partial invariance specified by the $\Delta\chi^2$ tests. The progressive strategy based on the χ^2 difference was followed (Byrne, 2010).

Only the variables CON2 (availability and quality of stores), AMB1 (cleanliness of airport facilities), and MOB2 (wayfinding) presented a significant difference between groups. This finding suggests that these items are operating somewhat differently for international and domestic passengers. This may be related to the differences in the interaction and behavioral patterns of each group of passengers. For instance, usually international passengers may carry more luggage and they are asked to arrive at the airport with more antecedence prior to the flight departure time. Passengers with more luggage are usually more awkward for moving within the terminal and check points (De Barros and Tomber, 2007). The effect of the amount of time spent in the airport on passenger perception has already been stressed (Bezerra and Gomes, 2015; Crawford and Melewar, 2003). Moreover, there may be substantial difference between domestic and international areas/terminals as regards retail area and convenience facilities within the airport setting.

As regards the covariances, only the covariance between the factors check-in and basic facilities were nonequivalent. This covariance had no statistical significance for the group of international passengers while it was significant for domestic passengers. This parameter estimate was low for both groups, which was expected, as the variables measuring each factor are quite independent.

Overall, these results support the suitability of the ASQ model for both groups of passengers. In summary: a. existence of configural invariance between groups; b. indication of equivalence provided by the ΔCFI tests; and c. the nonequivalent parameters identified by $\Delta\chi2$ are just a small number within the measurement model (no more than one per factor).

Accordingly, it is reasonable to assume that the partial

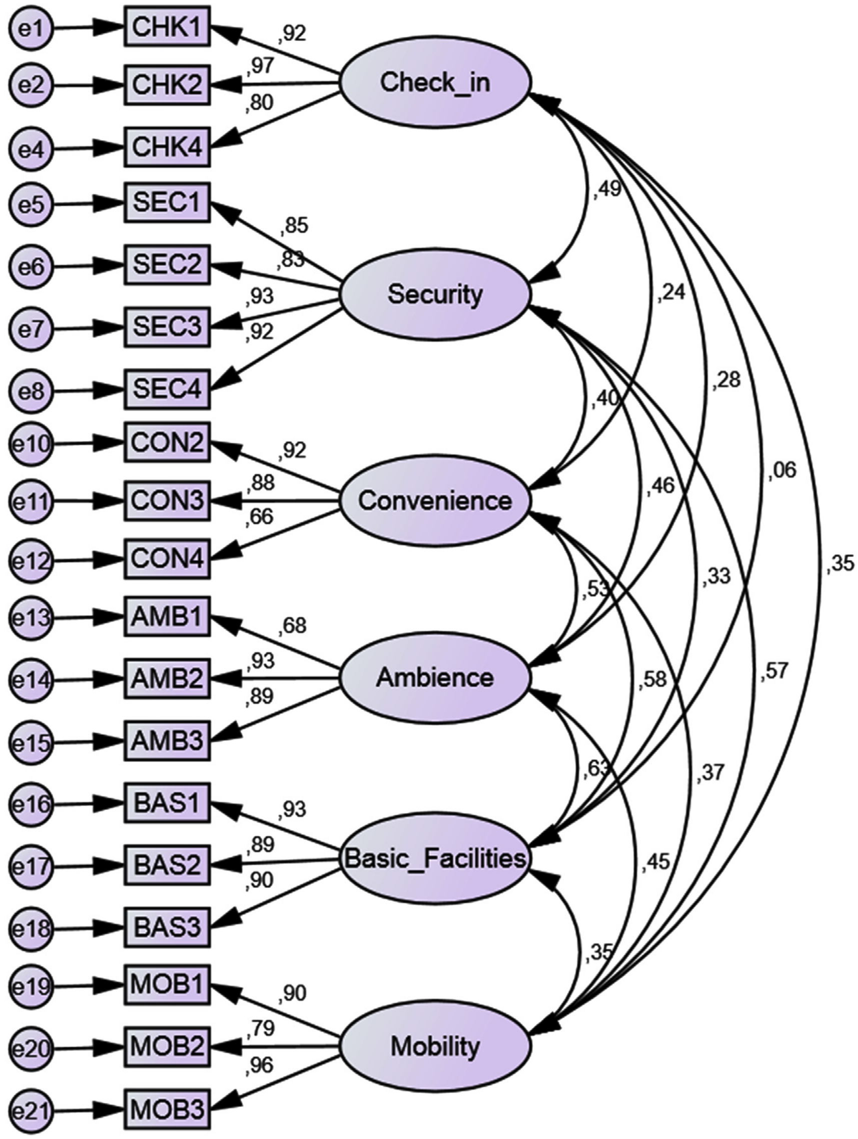

Fig. 1. CFA model output for international departing passengers.

Table 4
Models comparison.

Model	CMIN	DF	CFI
Unconstrained	795.140	274	0.967
1. Factor Loadings constrained	849.252	287	0.964
2. Factor Loadings and covariance constrained	880.741	302	0.963

Note: Assuming model unconstrained to be correct.

invariance identified by the $\Delta\chi 2$ tests does not compromise the suitability of the model for domestic and international passengers and should not inhibit the use of the measurement model (Cheung and Rensvold, 2002; Sass, 2011).

5. Conclusions

An effective airport service quality (ASQ) measurement is a relevant issue for practitioners and researchers. Although measurement practices are common within the airport industry, little attention has been given to the validity and reliability of the measurement instruments. Focusing on this gap, we aimed to fit a measurement model for perceived ASQ, and afterwards, to test for its equivalence across groups of passengers.

The results suggested that a six-factor model based on typical measures within the airport industry might provide a meaningful multi-item instrument for measuring passenger perception of ASQ. The measurement items were properly explained for the respective service quality factors whether the respondent was an international or a domestic departing passenger.

As airports are complex service settings, generic approaches for measuring service quality might not cover some specific characteristics related to the passenger–airport interaction (George et al., 2013; Pantouvakis, 2010). The proposed model covers relevant issues related to passenger perception regarding ASQ. It comprises the performance of core airport processes (check-in and security screening), along with aspects related to the passenger–airport interaction on his/her way through the terminal, leisure/convenience alternatives, and airport servicescape. It should be noted that in airport business dynamics, those aspects are closely related. In effect, efficient and reliable processes may result in more relaxed passengers with more time for discretionary activities and, consequently, more likely to stay and purchase in the airport retail areas

(Crawford and Melewar, 2003; Jeon and Kim, 2012).

This proposed model may represent a suitable alternative for a more parsimonious and practical analysis of ASQ, instead of considering a vast set of items individually. Since the perceived level of quality is an antecedent of passenger satisfaction and his/her attitude towards the airport, measuring service quality according to this approach may support airport managers and other decision-makers with a passenger-oriented focus for airport planning and management. This research effort may contribute to a more comprehensive understanding of ASQ as perceived by passengers. Particularly, it stresses the need for reviewing current practices for measuring and analyzing service quality within the airport industry. Changing ASQ analysis from the service-attribute level to a multidimensional approach, as already emphasized, implies assuring the validity and reliability of the measurement instruments used.

As to future research, since customers perceptions are obviously subjective and context dependent, testing for the suitability of this factor-structure in different airport settings is needed. Moreover, future developments of the measurement model should consider broadening the approach to the airport service environment. For instance, the addition of variables related to the convenience services/facilities and airport servicescape should be very useful, particularly for assessing the effects of the airport environment on passenger purchasing behavior and post-consumption attitude. Finally, concerning the need for extracting the most relevant information with respect to ASQ, the airport industry could benefit greatly from the advances seen in other service settings, namely the modeling of the antecedents and consequences of customer satisfaction.

Appendix A. Sample characteristics

Table A.1
Sample characteristics.

	International		Domestic	
	Freq.	%	Freq.	%
Nationality				
Brazilian	683	94.6	370	94.1
Other	39	5.4	23	5.9
Total	722	100.0	393	100.0
Gender				
Male	346	47.9	234	59.5
Female	376	52.1	159	40.5
Total	722	100.0	393	100.0
Travel frequency (in the last 12 months)				
0 to 2 trips	79	10.9	164	41.7
3 to 5 trips	395	54.7	136	34.6
>5 trips	248	34.3	93	23.7
Total	722	100.0	393	100.0
Trip purpose				
No business (Includes leisure and other purposes)	443	61.4	252	64.1
Business	279	38.6	141	35.9
Total	722	100.0	393	100.0
Antecedence of arrival at the airport				
Less than 1 h	2	0.3	59	15.0
Equal or more than 1 h and less than 2 h	27	3.7	189	48.1
Equal or more than 2 h and less than 3 h	187	25.9	74	18.8
Equal or more than 3 h	506	70.1	71	18.1
Total	722	100.0	393	100.0

Appendix B. Airport service quality factors

Table B.1
Description of the ASQ factors.

Factors	Comments
Check-in	Includes typical service performance indicators, such as passenger perceptions related to wait-time, process efficiency and attitude of service staff.
Security	Comprises wait-time and attitude of service staff. Includes the thoroughness of security screening and passenger's feeling of safety, which are aspects of a wider perception of ASQ.
Convenience	Reflects on the availability and quality of convenient facilities and services. As commercial revenues are critical for airport sustainability, providing alternatives for passengers enjoying their free time is a very important issue. As regards future developments, other items should be included to provide a more comprehensive indication of passenger perceptions regarding this ASQ factor.
Ambience	Comprises the environmental surroundings of airport terminal, including thermal and acoustic comfort, and airport facilities cleanliness. The airport physical environment is nonetheless critical for passenger evaluation of ASQ. Researches have tried to provide further understanding on how it is perceived and how it can affect passenger satisfaction (Fodness and Murray, 2007; Jen et al., 2013; Jeon and Kim, 2012). Developments should embrace outcomes arising from these studies and others.
Basic facilities	Differentiates from the Ambience for comprising items associated with the satisfaction of the most basic passengers needs during their stay at the airport. Washroom facilities availability and cleanliness, as well as departure lounge facilities, are basic elements for airport design (Horonjeff et al., 2010) and typical examples of dissatisfiers as assumed as prerequisites for airport service performance (Mikulic and Prebežac, 2008).
Mobility	Comprises aspects related to wayfinding, flight information and the walking distance inside the terminal. Mobility is a major concern for airport design and operations. Proper mobility solutions may help minimize the time and uncertainty for passengers when moving within the terminal and allow passengers to stay more relaxed at their interaction with the airport setting.

Appendix C. CFA estimates

Table C.1
Standardized regression weights.

Estimates			International passengers	Domestic passengers
CHK1 – Courtesy and helpfulness of check-in staff	←	Check-in	0.916*	0.917*
CHK2 – Check-in process efficiency	←	Check-in	0.974*	0.933*
CHK4 – Wait time at check-in	←	Check-in	0.804*	0.667*
SEC1 – Feeling of being safe and secure	←	Security	0.849*	0.693*
SEC2 – Courtesy and helpfulness of security staff	←	Security	0.827*	0.823*
SEC3 – Thoroughness of security screening	←	Security	0.928*	0.819*
SEC4- Wait-time at security checkpoints	←	Security	0.919*	0.798*
CON2 – Availability and quality of stores	←	Convenience	0.923*	0.688*
CON3 – Availability of Banks/ATM/Exchange	←	Convenience	0.878*	0.784*
CON4 – Availability and quality of food facilities	←	Convenience	0.659*	0.654*

(continued on next page)

Table C.1 (*continued*)

Estimates		International passengers	Domestic passengers
AMB1 – Cleanliness of airport facilities	← Ambience	0.677*	0.803*
AMB2 – Thermal comfort	← Ambience	0.934*	0.803*
AMB3 – Acoustic comfort	← Ambience	0.891*	0.833*
BAS1- Cleanliness of washroom/toilets	← Basic Facilities	0.933*	0.863*
BAS2 – Availability of washroom/toilets	← Basic Facilities	0.891*	0.825*
BAS3 – Departure lounge comfort	← Basic Facilities	0.900*	0.688*
MOB1 – Walking distance inside terminal	← Mobility	0.899*	0.736*
MOB2 – Wayfinding	← Mobility	0.789*	0.839*
MOB3 – Flight information	← Mobility	0.956*	0.788*

Note: *Significant at <0.001 level.

Table C.2
Correlations.

Estimates	International passengers	Domestic passengers
Check-in ↔ Security	0.494*	0.622*
Check-in ↔ Convenience	0.240*	0.407*
Check-in ↔ Ambience	0.281*	0.500*
Check-in ↔ Basic Facilities	0.060	0.324*
Check-in ↔ Mobility	0.346*	0.421*
Security ↔ Convenience	0.404*	0.538*
Security ↔ Ambience	0.460*	0.596*
Security ↔ Basic facilities	0.332*	0.463*
Security ↔ Mobility	0.569*	0.677*
Convenience ↔ Ambience	0.531*	0.603*
Convenience ↔ Basic facilities	0.583*	0.630*
Convenience ↔ Mobility	0.372*	0.529*
Ambience ↔ Basic facilities	0.629*	0.712*
Ambience ↔ Mobility	0.446*	0.522*
Basic Facilities ↔ Mobility	0.355*	0.499*

Note: *Significant at <0.001 level.

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