A NEW PERSPECTIVE ON MODELING OF AIRLINE PERFORMANCE

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ABSTRACT

This paper presents a structural equation modelling for the analysis of performance in airline companies. The model explicitly investigates a relationship between performance of airline companies and economic indicators, taking into account the internal factors. Each of these variables is conceptualized as a latent measure indicated by multiple indicators. The study includes 214 airline companies selected from a list of active companies in 2009. The results indicate that the model is applicable in estimating performance in airline companies and economic situations affect their performance. Furthermore, the relation of internal variables on airline performance was significant when controlling for economic variables.

Field of Research: Airline performance modelling, latent variables, structural equation modelling.

1. Introduction

Measuring and estimating the performance of airline industries has always been of interest to airline management team and researchers. In this regard, some researchers focused on financial indicators to estimate performance in airline industry (Feng & Wang, 2000; Guzhva, 2008; Riley, Pearson, & Trompeter, 2003; Scheraga, 2004; Wang, 2008), while some only dealt with non-financial indicators (Devriendt, Burghouwt, Derudder, De Wit, & Witlox, 2009; Flouris & Walker, 2005; Piga & Gaggero, 2009; Riley et al., 2003). There were also studies that focused on both financial and non-financial airline performance (Duliba, Kauffman, & Lucas Jr, 2001; Pachon, Erkoc, & Iakovou, 2007; Tsai & Kuo, 2004). The current study proposes the use of multi-performance indicators as suggested by Duliba et al. (2001) but each of the variables is conceptualized as a latent measure indicated by these indicators.

Most studies (Duliba et al. 2001; Feng and Wang 2000) conducted on estimation of performance in airline industry only took into account internal indicators as these factors are under the control of the companies. Nevertheless, this study seeks to employ an external factor, that is, economic indicators which are not under the control of the airline management team. We believe that these indicators influence the airline performance directly or indirectly.

2. Background

One of the most important economic factors used in a variety of economic research is Gross Domestic Products (GDP), which has been treated as one of the effective factors on performance of airline since
2000. For example, a study conducted by Ramanathan (2001) is one of the first studies which has investigated the performance of airline industry according to economic variable of GDP and other internal variables of the companies. The sample population in this research was airline industry in India and the researcher used the concepts of error correction and co-integration to analyze the data. The overall results demonstrate that, in India, the passenger-kilometres (PKM) are likely to rise faster than GDP, and even much faster than urbanization. The tone-kilometres (TKM) are significantly associated with industrial growth, and are likely to increase more quickly than the industrial production index. This factor also affects the demand rate in airline industry, i.e., when the GDP increases, the number of people's travel increases accordingly which can be attractive to entrepreneurs coming into the business (Hanpobamorn, 2007). Therefore, air travel demand is generally depends on GDP although the growth of demand is faster than GDP (Hanlon, 2006).

Some research papers have attempted to assess the extent to which airline may be affected by present economic indicators. For example, Oum et al. (2009) estimated a model which included variables such as fuel prices, GDP, and some other dummy variables to reflect influential events such as SARS, September 11th in 2001, and Asian financial crises which rocketed the world in all arenas, especially, economics. They used aggregated data collected from 1980 to 2008 to find out how these indicators affected total air passenger — domestically and internationally. Similarly, in another research, Gillen (2010) employed the data gathered from 1996 to 2008 to study international traffic, specifically in eight regions around the globe. In this study, the dependent variable was "Revenue Passenger Kilometre" (RPK), and the independent variables were total trade in merchandise and services, GDP, fuel price, foreign direct investment into the region, variables such as September 11th and SARS, and a connectivity variable. Two recent studies by Oum et al. (2009) and Gillen (2010) examined the performance impact on the GDP on an aviation industry. Another research which studied the impact of GDP on performance of airline industry is a research by Hourani and Helander(2009) conducted in the Europe region. The economic variable has also been examined in smaller research regions in various countries, such Guzhva and Pagiavlas (2004), Pierson (2009) and Cosmas(2009) in the United States and Bettini and Oliveira (2008) in Brazil.

Inflation rate is another economic indicator that has a significant impact on the economy of countries as well as the organizational performance based on which consumer’s purchasing power can be assessed and evaluated. This economic factor has also been employed for assessment of performance of airline industry (Aderamo, 2010; Jenatabadi & Ismail, 2007). Yet, another indicator which has proved its importance among other factors during recent decades is the Human Development Index (HDI). However, this factor has never been used in studies related to airline industry. The present research intends to use HDI along with both Inflation Rate and GDP in order to identify latent economic indicators.

3. Conceptual Framework and Research Hypothesis

The key interest for this research is to find out whether the relationship between economic indicators and airline performance is positive and significant. This paper also seeks to investigate the mediation role of internal indicators in affecting performance. The conceptual research model of this study is presented in Figure 1.
Airline Performance is combination of financial and non-financial performance. Based Duliba et al., (2001) research, four variables can be taken into consideration for measuring airline performance: load factor and market share as non-financial performance, whereas revenue passenger kilometre and operating profit for financial performance. Internal indicators are the main factors in airline industry that can be changed by the management based on company's strategies and policies. Four factors are contained in this construct based on Duliba et al., (2001) study, i.e.: number of departure, average stage of length, advertising expenses, and vehicle kilometre. Economic indicators cannot be controlled by organizations and their influence depends on the economic situation of the company. Variables such as inflation rate (Jenatabadi & Ismail, 2007), gross domestic products (Gillen, 2010), and human development index are used as economic indicators in this study.

Four main hypotheses can be stated as below:

H$_1$: Economic indicators is positively related to internal indicators
H$_2$: Economic indicators is positively related to performance
H$_3$: Internal indicators is positively related to performance
H$_4$: Internal indicators is a mediator in the relationship between economic indicators and performance.

3. Methodology

3.1 Method

In current years, SEM has attracted the attention of many researchers and organizations as a commonly adopted method used for tasks like data analysis in various disciplines (Garver & Mentzer, 1999) such as accounting (Smith & Langfield-Smith, 2004), logistics (Garver & Mentzer, 1999), education (Chen, Chen, & Chen, 2010; Teo, 2010), strategy management (Shook, Ketchen, Hult, & Kacmar, 2004; Williams, Edwards, & Vandenberg, 2003), marketing, business management (Baumgartner & Homburg, 1996; Steenkamp & Baumgartner, 2000), and Management Information System(Chin & Todd, 1995).

Path analysis is a particular type of SEM that has been used which is itself a GLM development. GLM is a second generation of the method of data analysis which depends on structural relationship exiting among variables of interest. SEM can carried out SEM softwares like AMOS (Analysis of Momentum Structures), LISREL, Mplus, EQS, and the like which were available and accessible to the researcher. These software packages were employed to evaluate and assesses the relationship among the collected
data, manifest, i.e., conceptual model including observed variables and latent hypothetical factors, i.e., latent constructs or unobserved variables (Hoyle & Smith, 1994).

3.1 Sampling

To obtain reliable estimates, the sample size should be large (Jöreskog & Sörbom, 1996). According to Kline (1998), a sample size bigger than 200 is considered as large. In this study, 214 airline companies form a total of 437 active companies in 2009. One company was deleted from the list due to missing data. Initial analysis of the data, i.e., using Mahalanobis Distance test, four airlines were removed from the list because they were considered as outliers which could affect the model fit and $R^2$. Therefore, the final volume of the sample used for SEM analysis in the current study consisted of 209 companies that form 48% of total number of airlines listed by ATW (Air Transport World) in 2009.

4. Findings

SEM is the best method for finding the interdependencies between economic indicators, internal indicators, and airline performance. Maximum Likelihood (ML) method was used to test for full SEM. Confirmatory Factor Analysis (CFA) is one of the data analysis procedures applied to the measurement model. In CFA, researchers attempted to find out the degree of model fits and resolve the gap of the fitting model with Modification Indices (MI). In this regard, Kline (1998) suggested that researchers should report a minimum of four tests that are acceptable and compatible with the fitting model. These tests include chi-square (in the AMOS software chi-square mentioned as CMIN); GFI, RFI, NFI, IFI, TLI, CFI, and RMSEA. The results of analysing the 209 airlines are shown in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Model fitting test</th>
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<tr>
<td><strong>Fit Index</strong></td>
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<tr>
<td>Chi-square Fit (p-value)</td>
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<tr>
<td>Goodness of fit index (GFI)</td>
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<tr>
<td>Relative fit index (RFI)</td>
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<td>Normed fit index (NFI)</td>
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<td>Incremental fit index (IFI)</td>
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<td>Tucker Lewis index (TLI)</td>
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<tr>
<td>Comparative fit index (CFI)</td>
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<td>Root Mean Square Error of Approximation (RMSEA)</td>
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</table>

Table 1 clearly shows that only four of the statistics, i.e., NFI=.916, IFI=.932, TLI=.908, and CFI=0.931, follow the model fitting. Hence, based on these results, it can be claimed that this structure fits the data very well.
Figure 2 displays the outcomes of the full structured model with standardized parameters. The relationship between two predictors, i.e. economic indicators as independent variable, internal indicator as mediator, and performance as dependent variable are determined by the proposed model.

The proposed model hypothesizes that performance of airline and economic indicators are, directly and indirectly, interrelated and mediated by internal indicators. The 11 elements with three unobservable items were taken into consideration in confirmatory factor analysis. The outcomes of direct effects between constructs are displayed in Table 2. The relationship between internal and economic indicators is significant and has a positive relationship, i.e., β = .21, C.R. = 3.016, p < .01. Moreover, it can be suggested that the relationship between airline performance and economic indicators is significant and positively related, i.e., β = .12, C.R. = 3.483, p < .01. Furthermore, the relationship between airline performance and internal indicators is also significant and positively related, i.e., β = .93, C.R. = 17.250, p < .01. Hence, the results shown in Table 2 support the first, second and third hypotheses of this paper.

Table 3 shows the direct, indirect, and total effect of each construct. The indirect effect is significant (Mathieu & Taylor, 2006) and bigger (Jiménez-Jiménez & Sanz-Valle, 2010) in comparison to the direct effects.
effect. From the results in Table 3, it can be confirmed that internal indicators act as a mediator in the relationship between economic and performance. This result provides support for fourth hypothesis of this research. Besides, the value of $R^2$ is 0.92. In other words, 92% of the changes that occur in performance depend on the internal and economic indicators.

### Table 3 Direct, Indirect, and Total Effect of the Model

<table>
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<tr>
<th>Outcome</th>
<th>Input</th>
<th>Standardized estimates</th>
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<tr>
<td></td>
<td>Economic</td>
<td>Direct</td>
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<tr>
<td></td>
<td>indicators</td>
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<tr>
<td>Internal indicators</td>
<td>Economic indicators</td>
<td>.21</td>
</tr>
<tr>
<td>Performance</td>
<td>Economic indicators</td>
<td>.12</td>
</tr>
<tr>
<td>(R$^2$ = .92)</td>
<td>Internal indicators</td>
<td>.93</td>
</tr>
</tbody>
</table>

5. Discussion

Findings of this study support past studies in that the internal variables such as number of departure, advertising expenses, average stage of length, and vehicle kilometre have significant impact on performance. This study also supports that the economic indicators have significant impact on performance and internal indicators. In fact, the impact is stronger on internal indicators than on performance (Figure 3). Therefore, economic indicators influence the performance both directly or indirectly. In direct mode, the economic indicators affect performance of a company without having any impact on its internal indicators. Airline companies have no ability to modify or control this influence. As an example, if the income and welfare increase, willingness of people to travel will also increase accordingly. In such a case, the economic variables have positive effect on enhancement of performance. On the other hand, if the inflation rate goes up, the tendency of people to travel by air will also slump, leading to the cutback of number of flights and reduction of overall performance of the company.

Another mode of effect of economic indicators on performance is not direct in which with any changes in economic conditions, or economic variables, company managers seek to find and apply strategies within the abilities of the company. Through some of these strategies such as changes in specific programs and schedules like number of flights or changing the long distanced destinations and routes to the shorter destinations, or vice versa, or through various advertisements and promotions, the airline companies can control their performance. These changes primarily affect internal indicators of the company, and consequently, the internal indicators alter the level of performance. Therefore, one of the contributions of this research is investigation of the direct and indirect effects of the economic indicators construct in a model. Based on the results presented in Table 3, it can be claimed that the
construct of internal indicators acts as a mediator between the economic indicators and performance, while in other studies they have been considered as independent variables.

In all the studies about performance, after introduction of the indicators, in order to evaluate the model, the researchers consider each of the performance indicators separately and provide different models for each indicator respectively. The main gap in such studies is that these models are not able to introduce a general indicator such as "overall performance" that is itself a combination of other indicators such as the number of flights, number of passengers and the like for introduction of performance. These models are not even able to introduce a single unified model for this purpose. Therefore, the current research intends to cover the gap with introduction of latent variable instead of measurement variable. Moreover, this study attempts to introduce a single unified model using the SEM method.

6. Suggestion for Future Studies

Top management team (TMT) is one of the most important topics which can be applied to assessment of organizational (Bowlin & Renner, 2008; Hambrick, Cho, & Chen, 1996; Pegels & Yang, 2000) and airline performance (Goll, Johnson, & Rasheed, 2008; Jones, 2006). It can be examined as a moderator in the relationship between constructs of Performance models.

References


