Analysis of Low-Cost Carrier Operations in Long-Haul Air Transport Markets

Urban, Marcia*; Hornung, Mirko†

Bauhaus Luftfahrt e.V., Willy-Messerschmitt-Straße 1, Taufkirchen, 82024, Germany

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Introduction

Market liberalisation and digitalisation paved the way for the introduction of novel airline business models such as the low-cost carrier (LCC) in the 1970s (Wittmer and Bieger, 2011). This led to an increasing acceleration of business processes and developments in the global air transport markets. Today, the LCC business model, which focusses on a price leadership strategy, is well-established in short-haul markets (Conrady et al., 2019). For almost two decades, several airlines have attempted to introduce low-cost services in long-haul distance markets, i.e. routes of 4000 km or more, such as AirAsiaX or Jetstar in the Asia Pacific market and Norwegian, Eurowings, Westjet, and Wow Air in the transatlantic market (Soyk et al., 2017). The question remains whether the LCC business model can be operated sustainably on long-haul routes, and if possible, what strategies are required to maintain solvency in the long run. Since the transferability of the low-cost business model to long-haul markets gains interest in the scientific community (Francis et al., 2007; De Poret et al., 2015; Soyk et al., 2017), our research objective is to extend existing SD modelling capabilities of airline competition to incorporate specific long-haul market characteristics in an SD model of a long-haul air transport market. Studies on the airline cyclicality such as Liehr et al. (2001), Pierson and Sterman (2013) and Cronrath (2018) provide valuable input for the modelling of general airline dynamics such as the fleet development, the ticket price development and, in the case of Cronrath (2018), revenue management. Key drivers for air transport demand, i.e. population and GDP, from these previous studies were adopted into our model. Regarding market segmentation and passenger choice, the air transport market model builds on model structures from Kleer et al. (2008), Pfaender (2006) and von Beuningen (2014). We further develop the model structure resembling two different airline types, the full-service network carrier (FSNC) and the long-haul low-cost carrier (LHLCC), to fit the conditions of the transatlantic air transport market.

Overview of the air transport market model

We developed an SD model of the transatlantic air transport market to represent interrelations between two airline business model types and feedback loops between airline strategies and the air passenger groups' reaction to these strategies. These airline strategies include an airline's ticket price development and capacity management in terms of aircraft fleet and flight frequency. The air transport market model is applied to investigate the development of market shares of FSNCs and LHLCCs in the transatlantic market. The modelling software AnyLogic was utilised for the model development. The major actors in the model are the air transport passengers and the airlines which operate in the transatlantic air transport market. The passengers are grouped into two groups or market segments: leisure and business passengers. Leisure passengers are more price-sensitive and business passengers are more time-sensitive (Conrady et al., 2019). The interaction between the demand and the supply side is a central element of the model. Demand and supply balance strongly depends on several capacity, price and service-related characteristics of the flight offered by an airline and the customers' perception of these characteristics. To cover these key elements, the model is divided into three modules: the demand generation, the passenger choice, and the airline market.

The validation of SD models comprises different model testing levels: testing of the model behaviour and testing of the model structure (Barlas, 1996). Behavioural model testing is mostly performed with a set of statistical tests. Although testing the model structure is crucial for the validity of the internal structure of a model, a common approach for this is less elaborated in the literature (Barlas, 1996). Regarding the model behaviour testing, two model fit statistics were selected to express the quality of the model fit to the historic data. These statistics are applied to the base run of the model for the time range between 2014 and 2017. This time range was selected because the first services of LHLCCs in the transatlantic market on routes over 4000 kilometres were operated in June 2014 by Norwegian Air Shuttle (see Sabre Data). AnyLogic provides automated optimiser simulation experiments which minimises the difference between model simulation data and known historic data. The optimiser function *difference()* calculates the square root of the average square of the difference between the two datasets (AnyLogic, 2020). Besides behaviour model testing, the validity of the model structure was tested implicitly during the model development process. The results of these model structure validity tests achieved a level that allowed confidence in the model structure.

* Research Assistant Economics & Transportation, marcia.urban@gmx.de (corresponding author)

† Director Research and Technology, mirko.hornung@bauhaus-luftfahrt.net

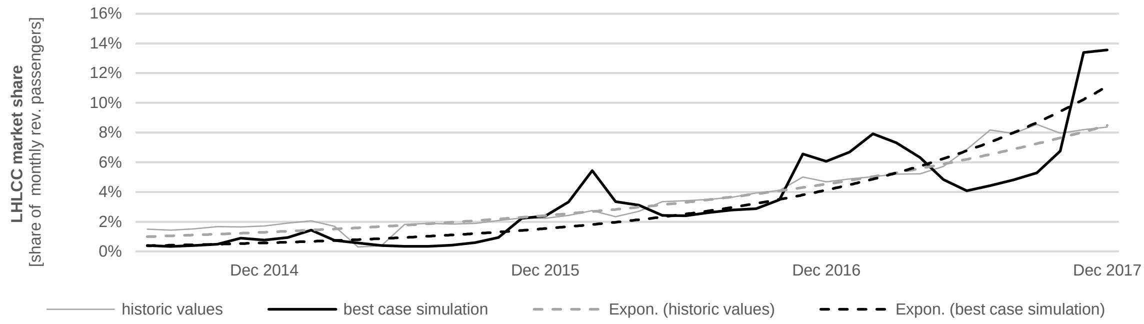

Figure 1: Calibration results: LHLCC market share (historic values: Sabre 2014 – 2017 EU-NA OD database (Sabre, 2014-2017))

Figure 1 represents the best case simulation results for the market share of the LHLCC airline type (solid black line) as well as an exponential trend line following the development of the market share (black dashed line). When we compare these results with the historic market share (grey solid line) and its trend (grey dashed line), it appears that the amplitudes of the simulated LHLCC market share are larger than the historic data. The two trend lines follow the same slope, with the historic data showing a 1 % larger market share than the simulation between June 2014 and June 2016. The simulation trend increases its slope up to a market share of 11 % compared with 8.5 % of LHLCC market share in December 2017. This difference might result from a non-cyclical increase in the seat capacity of the LHLCC and a following larger number of monthly revenue passengers transported compared with the historic data. However, both trend lines resemble an exponential growth after the market entry of the LHLCC. This development is in line with the theory of innovation diffusion processes of novel technologies (Milling, 1996; Grubler et al., 2016). In the long-term, it is expected that the LHLCC market share will follow an s-shaped curve with an initial exponential growth and an alignment to a maximum market share of a market equilibrium setting.

Scenario simulation of the transatlantic air transport market

The transatlantic market is saturated in terms of annual growth in passengers or passenger kilometres operated. However, today, the introduction of low-cost services is still at an early stage with a certain future growth potential. Two scenarios are presented and compared with a baseline scenario S_B that comprises the parameter settings for the adjustment times of capacity, orders, and ticket prices from the calibration run. In scenario S_1, both airline types have the same adjustment times with fleet capacity adjustment of 2 years, order adjustment of 6 months and a rather short adjustment of 2 months for the ticket prices. Scenario S_2 focusses on a dedicated airline business model characteristic: the availability of a frequent flyer program. Such a reward system enables the passengers to collect loyalty points which can be redeemed for an upgrade on the next flight or luxury products. It is usually offered by the FSNC airline type as a customer loyalty measure (Conrady et al., 2019).

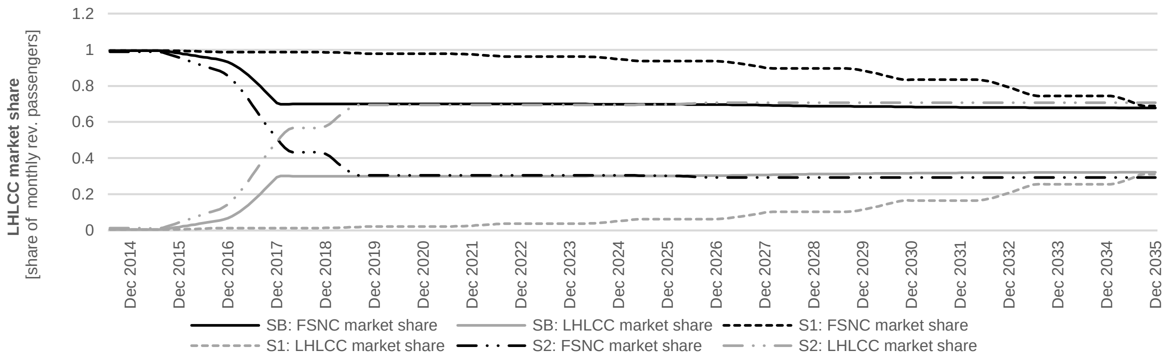

Figure 2: Comparison market share development until 2035 between a baseline (S_0), a scenario with equal supply and ticket price adjustment times for FSNC and LHLCC (S_1), and a scenario with FFP availability from both airline types (S_2)

The simulation results are preliminary. They are provided to explore the potential utility of the model now and in the future. We compare the baseline calibration with scenarios S_1 and S_2. The preliminary simulation results show that the general model functionalities resemble the positive effect of increasing attractiveness of the LHLCC, due to the FFP availability, on the overall market share of this airline type. In other words, the LHLCC market share increases from 30 % (S_0) to 70 % (S_2) when this airline type offers a reward program (FFP). Yet, the results also indicate that the preference weights might need to be adapted to meet the specific characteristics of the transatlantic market. We would assume, that compared with the preference weights taken from a study of the short-haul market (Ostrowski et al., 1991), these might shift towards a stronger importance of connectivity in terms of frequency, especially for business passengers, which might result in a reduction of the importance of other preferences. However, there should be further investigation and literature research on whether comparable passenger choice characteristics have been collected or defined in the scientific discourse.

Conclusions and future work

Results show that the transatlantic air transport model presented resembles historic data between 2014 and 2017 during the market entry of the first LHLCCs. However, not all calibration results are statistically significant which is why some more effort should be put in modelling the airline decisions and in the calibration of the model. Furthermore, the scenario simulation results reveal an expected LHLCC market share potential of 30 % on the transatlantic market. This market share potential is determined by the assumed passenger preference weights for the two airline types. The duration up to which this market share potential is fully achieved ranges between 4 and 21 years. The availability of FFP when booking a flight with the LHLCC type tremendously increases the maximum market share potential to 70 %. It is questionable whether this result resembles a feasible scenario since the overall market potential of LCCs in long-haul markets is expected to be lower compared to the market shares achieved by LCCs in established short-haul markets such as in the United States of America or Europe (Francis et al., 2007). Another important aspect is the fixed market shares that both airline types reach due to fixed preference weights which determine the resultant equilibrium. Previous studies about the introduction of alternative fuel vehicles (e.g. Struben and Sterman, 2008) include influences from adaptation and familiarisation with these new technologies and their uptake and establishment. These effects could be implemented in the model to consider the effect of passengers collecting experiences with the new airline type in the transatlantic market and potentially shift their preferences in favour of the LHLCC.

Future research will focus on the improvement of calibration results as well as the investigation of further improvement potential of the model structure by integrating the aspects discussed above to extend the range of scenario simulations, to elaborate on the confidence in the model results and to improve the overall approach. Also, the model equilibrium settings should be further investigated and comparative simulation studies between a monopolistic market in comparison with competition between FSNCs and LHLCCs could be conducted to analyse potential benefits for passengers resulting from competition in this market. Furthermore, the fuel price development, as well as the number of average seats and the distance flown, could be integrated endogenously into the model to include effects from changes in these parameters on the operating costs of an airline type. A version of the full conference paper can be requested from the corresponding author (M. Urban) via e-mail.

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