



A market attraction model for predicting the US market share of large civil aircraft

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Abstract

With global annual sales exceeding \$65 billion, the large civil aircraft industry is an important economic and strategic element of the European Union and US economies. Here we define large civil aircraft (LCA) as those aircraft with capacities exceeding 121 passengers and dedicated to the air passenger market served by commercial airlines. This paper employs a transformed log-centered market attraction model to forecast the US market share of LCA. This model specification ensures that the predicted market share is in the range $[0,1]$ and that the sum of all predicted market shares is equal to 1.0, both logical process requirements. In this special case, where there are two producers, the market attraction model becomes a logit regression model. Here we specify the logit regression model as an autoregressive distributed lag model in which US market share is predicted by quantitative and qualitative predictor variables, an autoregressive lag operator and a linear trend component. © 2000 Elsevier Science Ltd. All rights reserved.

Keywords: Market share model; Logit regression; Large civil aircraft

1. Introduction

We define large civil aircraft (LCA) as those aircraft with a passenger capacity exceeding 121 passengers and dedicated to the air passenger market served by commercial airlines. The LCA industry is of significant strategic and economic value to the US and the European Union (EU). Global annual sales of LCA exceeded \$65 billion in 1996, with these sales generating politically important jobs and exports. This paper describes predictive models for the US share of world and regional markets for three different classes of LCA.

Until the late 1970s, US producers held an almost 100% market share in virtually all segments of the LCA market. However, major structural changes within the LCA industry over the past 25 years have resulted in dramatic US market share erosion, and the loss of this preeminent position. This loss in market leadership, coupled with the significant research and capital investment expenditures associated with the LCA industry, underscores the importance of identifying factors driving market share. A previous study by the US International Trade Commission (1993) reported limited success devel-

oping a regression model explaining the US share of world orders for LCA. This limited prior success and the little published empirical modeling of the market share of US LCA producers were the motivating factors for the present study.

In this paper, we present a set of market attraction models for the US market share for three different classes of LCA. The market attraction models used are linear regressions that, in this application, take the form of logit regressions. The logit regression models are specified as autoregressive distributed lag models in which US market share is predicted by both quantitative and qualitative predictor variables, an autoregressive lag operator and a linear trend component. This model form insures logical consistency in predicted market share values (i.e., predicted US market share in the range $[0,1]$ and predicted US and foreign market shares that sum to 1.0).

The paper begins by providing a general overview of the LCA industry, including the classification system used to segment the LCA marketplace. The following section then describes the variables used in the current study, their nature and sources. Specifications for three commonly used market share models (i.e., the linear, multiplicative and market attraction models) are then provided as background to prior work in the field. We then show that in the special case of two producers, the market attraction model degenerates into a logit

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regression. The paper concludes with presentation and interpretation of the results.

2. The LCA industry

Prior to the founding of Airbus Industrie (AI) in the late 1970s, US producers dominated the world market for LCA. AI has over the past 30 years captured significant market share, and in the process catalyzed attendant structural changes in the industry. At present there are only two major LCA producers in the Western World (the Boeing Corporation of the US and AI of the European Union) and one minor producer (British Aerospace Regional Aircraft of the United Kingdom). Other non-Western producers exist, most notably Ilyushin and Tupolev of Russia, but they have had little success in selling to other than their internal domestic market and in the near term are not considered to be major global producers.

Historically, the LCA market is segmented according to aircraft type and world region of the purchasing airline (US International Trade Commission, 1998). Following the Boeing (1997) convention, aircraft models are classified according to average seating capacity, as shown in Table 1. Note that LCA are those aircraft types representing the airframes that correspond exclusively to large commercial jet transports.

In accordance with the Boeing (1997) convention, the LCA world market is divided into the following regions:

- *Region 1:* The United States — the United States and its possessions, e.g., Guam and Puerto Rico;
- *Region 2:* Europe — countries of Western, Eastern and Southern Europe;
- *Region 3:* Asia-Pacific — China, Southeast Asia, the Indian subcontinent and Australasia; and,
- *Region 4:* Rest-of-the-World — Central and South America, Canada, the Caribbean, the Middle East and Africa.

Specific countries within each group may be found in *Current Market Outlook* (Boeing, 1997). The nation members of the Commonwealth of Independent States (the

former Soviet Union) are not included since their market has historically been, and continues to be, limited to domestic producers.

3. The LCA market

The LCA industry is of significant strategic and economic value to the US and the EU (March, 1990; US International Trade Commission, 1993,1998). Strategically, it is an important complement to the aerospace defense industry and is perceived as critical to the long-term national defense interests of both the US and the EU. With approximately \$180 billion (1996 dollars) in orders during the period 1971–1996, the LCA industry is also a significant generator of jobs and exports, and thus an important contributor to the economies of both regions (Fernandez, 1997). The LCA industry is particularly interesting not only because of its size and economic impact, but also because of the major structural changes that have occurred over the past 25 years. The most significant of these changes is the emergence of AI as a strong competitor in all LCA market segments with the exception of Type 8 aircraft, where US producers have retained an almost 100% share of the world market. With this exception, US producers have lost significant market share to AI in all other LCA market segments (i.e., all four regional markets for Type 5, 6 and 7 aircraft).

Market share is a widely used indicator of the competitiveness of a particular producer or set of producers. To capture the economic impact of market penetration, the market share values used in this study are based on the dollar value of annual new aircraft orders (i.e., the used aircraft after market is excluded). However, new aircraft sales tend to fluctuate dramatically from year-to-year due to the order variability inherent to the aircraft market (Fernandez, 1997; Wingrove et al., 1998). In order to reduce high-frequency variation, the market share data was smoothed using a two-period-based centered moving average (CMA) technique (Bowerman and O'Connell, 1987). Using centered moving averages eliminates irregular fluctuations from data and is particularly well suited to this application as it maintains a correspondence between the smoothed data and yearly time periods. The CMAs are based on two-period calculations so as to filter out very high-frequency noise yet minimize the loss of data, a particularly important issue here since there are a relatively small number of observations for developing predictive models. Table 2 shows smoothed yearly US market share values for Types 5, 6 and 7 aircraft, over the period 1971–1995. For each aircraft type, market share is given for each region and for the world as a whole.

Although each aircraft model has a nominal seating capacity, the actual capacity of a specific aircraft “as

Table 1
Aircraft type classifications^a

Aircraft type	Seating capacity
1	< 50
2	50–69
3	70–90
4	91–120
5	121–170
6	171–240
7	241–350
8	> 350

^aSource: Boeing (1997).

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