Airline Seats: An Econometric Investigation of Factors Affecting Their Supply

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Aviation is a quickly changing industry, with an unusual combination of fierce competition and cartel-like collusive agreements operating on similar routes. Donal Kane constructs a simple model for the supply of airline seats between different pairs of cities.

Introduction

The international air transport market is usually viewed as a coherent whole on a world or regional level; however, it is often more instructive and more analytically valuable to view it as a series of small interconnected markets between various city-pairs. While it can be said that the US market is buoyant, or that growth of the European market is expected with the recent full liberalisation, this is of little importance to detailed business planning. An airline is only peripherally interested in the market-wide demand; of far more significance is the level of demand on the individual airline's routes.

Detailed analyses of supply and demand for airline seats on individual routes are carried out by airlines on a frequent basis, as it is clearly a vital part of their business planning for new routes or schedule adjustments on existing routes. The model developed below is designed to provide an indication of the level of demand for air transport between two airports in relation to the size of the populations served, and the importance of the airports in the air transport network.

There are fairly well established relationships between various economic variables, and variables concerned with the aggregate air transport market. There is a positive correlation between GDP and the number of seat kilometres travelled. This declines in significance as the market reaches saturation. There is also a positive correlation between income per capita and propensity to fly. At the microeconomic level of individual routes, many other factors come into play which make the relationships much more confused and difficult to model, such as government regulation, competition, historical and linguistic links and subsidies.

Is it possible to establish a relationship between the size of an individual route and known factors about the route? For example, what are the effects of competition, city size, distance and price on a route? The model developed will attempt to address these issues.

Specification

Dependent Y-variable

Available Seat Miles (ASM) per week (000s): The Y-variable eventually chosen (ASM) was selected because it measured both the capacity and distance of the route. ASM was chosen over seats available for this reason, and also because all aviation analysis uses seat miles or seat kilometres as an important measure. ASM is obtained by multiplying the number of seats available by the length of the route. Thus, a 10 seat plane flying a 1,000 mile route and a 100 seat plane flying a 100 mile route would each generate 10,000 seat miles. ASM is a supply rather than a demand variable as the number of available seat miles is being considered rather than seat miles actually travelled. However, the two are likely to be strongly correlated, since the airline market is increasingly competitive and it can be safely asserted that the airlines would not supply the seats unless there is a reasonable prospect of enough of them being filled to generate a profit.

X-variables

Product of available connections: The X_1 variable is obtained by multiplying the number of destinations (not including the other airport in the pair), served by one airport in the city pair by the number of destinations served by the other. The use of the product of the connections rather than the sum of the connections is more realistic since it gives an indication of the maximum theoretical number of city pairs connected by the route in question. This is intended to provide a measure of both competition, since the larger the "hub" airports at the each end of the route the greater the number of airlines serving the route, and of the importance of the airports within the air transport network. The intention is to provide a measure of air travel demand by passengers, both those who have originated from one of the cities in the city-pair and those who are using both cities as a connection point on the route to some other destination. The variable is flawed as it does not distinguish between plausible and implausible connections. For instance it would count Philadelphia to Boston by way of London and New York as a plausible connection. Nor does it make any attempt to account for the frequency of connections, a route with one flight a week carries the same weight as a route with 30 flights a day.

Sum of Spending Power/Wealth (000,000s): The X_2 variable used in the model is an estimate of the combined GDP for the two cities which is found by multiplying each city's population by its GDP per capita. This is intended to provide a measure of the demand for air travel originating in the two cities. Where possible, the variable uses population figures for entire urban agglomerations. It would have been preferable to have figures for the population living within a set radius of the airport; however, such figures are not generally available. The GDP per capita is crudely calculated by multiplying the most recent national GDP per capita figure by the long term trend growth rate, to arrive at a figure for 1996. No allowance is made for GDP variations within the country.

Rejected X-variables:
It would be ideal to have been able to include data on prices. However, these data are impossible to obtain due to the exceptionally complicated fare system on many routes, for instance, on the London-New York route, there are several hundred different fares, only a small portion of which bear any relationship to the published IATA fares. Data on the number of airlines serving each route are possible to obtain; however, it was rejected as an X-variable in favour of the more illustrative X_1 variable concerning connections. The X_1 variable can, in some sense, be regarded as a proxy for price since competition is generally greater on larger routes between more important points on the global transport network. Trade data would have been a good indicator of the propensity for travel between two countries but it was rejected in favour of the X_2 variable due to severe difficulties in data collection and comparison.

Data
A representative sample of 30 international air routes was chosen to provide data for the model. The routes were chosen to provide contrasting levels of wealth, airport size, geographical spread and distance.

Data for the Y-variable were collected for a specific point in time - the first week of September 1996. The OAG/ABC World Airline Guide, listing all scheduled airline flights, was used to obtain these data. City to city schedules in the guide were used to obtain the number of weekly flights on various airlines and aircraft. Many airlines publish configuration plans for their aircraft, so the number of seats on various aircraft is easy to obtain. The OAG/ABC guide contains ticketed point mileage tables. With all this information it is a simple task to derive a Y value for each route.

The X_1 variable data are simply obtained from the ABC/OAG by counting the number of destinations served by each city.

Population and GDP statistics were obtained from the Philips Geographical Digest and were cross checked with figures in the UN statistical handbook and other publications.

Evaluation
Model: The model developed was a simple linear 3 variable regression model taking the form

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + U_i$$

The aim of the evaluation is to produce numerical values for the parameters β_0, β_1 and β_2, and to establish the degree of statistical significance of the result.

Regression: OLS Regression analysis was carried out on the data using HUMMER and EXCEL software packages to evaluate the parameters for the model.

Initially, single regressions were carried out to evaluate the relationship between Y and X_1, and Y and X_2. To investigate whether the model contained significant problems of multicollinearity by calculating the correlation between X_1 and X_2 was calculated.

The regression of X_1 on X_2 indicated a satisfactory low degree of mulitcollinearity in the model, yielding an R-squared value of just 0.197, meaning that only 19.7% of the variations in X_1 are statistically explained by the variations in X_2. This is a satisfactory result.

The regression of Y on X_1 yielded a positive relationship with a high R-squared value, as expected.

$Y = -2694.04 + 1.872X_1$ R-squared = 0.544

The regression of Y on X_2 yielded a positive relationship between the two variables with a moderate R-squared value.

$Y = 6784.476 + 0.066X_2$ R-squared = 0.457

The multiple regression of Y on X_1 and X_2 was carried out and yielded a high R-squared value, whose validity is supported by the low degree of multicollinearity as discussed above.

$Y = -7707.12 + 1.383299X_1 + 0.042238X_2$ R-squared = 0.695071

Conclusions

The model would appear to have a high degree of explanatory power. The relationship between Y and both X variables is positive in both the single and multiple regression cases, and of similar magnitude. Clearly the model does have some value in explaining the relationship between the supply of air travel and the factors influencing its demand at the level of individual routes. However, its uses would be extremely limited. By taking a cross section at a particular point in time rather than a time series, all effects of seasonality have been ignored so as to render it quite useless for serious business planning. It is imperfect as it does not allow for the possibility that the demand for travel between two cities may be met by means other than scheduled airline transport. This distortionary effect would be significant on short routes where surface transportation is a viable alternative, or on routes with a high degree of non-scheduled, charter, air traffic.

The use of such a simple model for airlines predicting demand for an individual route would be implausible. While concentrating on two very fundamental variables affecting route size, the model completely ignores the effect of so many other smaller variables which may cumulatively have a far greater effect on the airline's decision to enter a particular market. The effects of marketing, the price level, the first/business/economy mix, all so crucial to an airline's profitability, are all ignored in this model along with countless other variables.

The model is useful for gauging the approximate level of overall supply for a route, and may usefully tell us if a route is saturated or not, or if there could be space for extra capacity. However, it cannot be said to be a useful guide for an airline to evaluate entry on to a particular route - such a simple model has to leave so much out.

Bibliography

Data Sources

OAG/ABC World Airline Guide September 1996, Reed publishing.

Philips Geographical Digest

Books

Doganis, Rigas (1991) *Flying Off Course, The Economics Of International Airlines, Routledge, London.*

Graham, Brian (1995) *Geography and Air Transport, John Wiley, Chichester.*

Hanlon, Pat (1996) *Global Airlines, Competition in a Transnational Industry Butterworth-Heinemann ,Oxford.*