Market Conduct of the Three Busiest Airline Routes in China

Qiong Zhang, Hangjun Yang and Qiang Wang

University of International Business and Economics

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Introduction

- In this paper, we empirically investigate the market structure and competitive behavior in the Chinese airline industry by employing a "conjectural variations" (CV) approach.
Introduction

- Motivation
  - China is the largest civil aviation market in Asia. Aviation market in China attracted the attentions of many international carriers, but academic is limited because of poor data.

  - Three major state-owned airlines, Air China (CA), China Eastern Airlines (MU), and China Southern Airlines (CZ). Debates center on the issue of whether the competition among the Chinese airlines is excessive, or whether the airline industry is becoming too concentrated.
Introduction

• Focus

  – The three busiest airline routes that link Beijing, Shanghai, and Guangzhou
  —— the largest hub airports in China
  —— golden routes
Literature

- Application of the CV approach
  - rubber industry, cement industry, electrical power markets, etc.

- A number of empirical studies employ CV to investigate market power in the airline industry
  - Brander and Zhang (1990, 1993)
Overview of Airlines’ Market Power

- The three major airlines control the whole market

Figure 1: Market shares of the three major state-owned airlines
Overview of Airlines’ Market Power

Each city-pair route is characterized by duopoly

Table 1: Percentages of connecting RPKs on the three routes

<table>
<thead>
<tr>
<th>Routes</th>
<th>Carriers</th>
<th>2010_1</th>
<th>2010_2</th>
<th>2010_3</th>
<th>2010_4</th>
<th>2011_1</th>
<th>2011_2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing-Shanghai</td>
<td>CA</td>
<td>0.366</td>
<td>0.375</td>
<td>0.329</td>
<td>0.339</td>
<td>0.343</td>
<td>0.349</td>
</tr>
<tr>
<td></td>
<td>CZ</td>
<td>0.026</td>
<td>0.023</td>
<td>0.025</td>
<td>0.026</td>
<td>0.027</td>
<td>0.023</td>
</tr>
<tr>
<td></td>
<td>MU</td>
<td>0.556</td>
<td>0.548</td>
<td>0.605</td>
<td>0.586</td>
<td>0.572</td>
<td>0.568</td>
</tr>
<tr>
<td>Beijing-Guangzhou</td>
<td>CA</td>
<td>0.431</td>
<td>0.408</td>
<td>0.383</td>
<td>0.386</td>
<td>0.396</td>
<td>0.391</td>
</tr>
<tr>
<td></td>
<td>CZ</td>
<td>0.478</td>
<td>0.498</td>
<td>0.541</td>
<td>0.528</td>
<td>0.51</td>
<td>0.529</td>
</tr>
<tr>
<td>Shanghai-Guangzhou</td>
<td>CA</td>
<td>0.062</td>
<td>0.081</td>
<td>0.098</td>
<td>0.083</td>
<td>0.1</td>
<td>0.065</td>
</tr>
<tr>
<td></td>
<td>CZ</td>
<td>0.384</td>
<td>0.391</td>
<td>0.413</td>
<td>0.416</td>
<td>0.398</td>
<td>0.423</td>
</tr>
<tr>
<td></td>
<td>MU</td>
<td>0.554</td>
<td>0.528</td>
<td>0.490</td>
<td>0.501</td>
<td>0.502</td>
<td>0.512</td>
</tr>
</tbody>
</table>
Modeling

- **Conduct Parameter**

Assume that the three big airlines supply a homogeneous product on the same route.

The profit function of firm $i$ can be written as

$$\pi_i = p(Q)q_i - C_i(q_i).$$  \hfill (1)

$q_i$ is the quantity supplied by firm $i$, $Q$ is the total output.

$p = p(Q)$ is the inverse demand function.

$C_i(q_i)$ is the total cost of firm $i$. 
Modeling

• Conduct Parameter

Through the first-order condition, the conduct parameter is defined as

\[
\frac{dQ}{dq_i} = \frac{p - MC_i}{p} \cdot \eta \cdot S_i,
\]

(2)

\( \eta = -(dQ / dp)(p / Q) \) is the price elasticity of demand

\( S_i = q_i / Q \) is the market share of firm \( i \),

\( MC_i \) is the marginal cost of firm \( i \).
Empirical Results

- **Elasticity of Demand**

The feasible generalized least squares (FGLS) method is used to estimate the model. The estimated equation (standard errors in parentheses) is

\[
\ln(Q_{kt}) = -44.81 - 0.90 \ln p_{kt} + 5.78 \ln POP_{kt} + 0.88 \ln INC_{kt} + 1.76 \ln DIST_k + 0.23 EXPO - 0.19 Spring + 0.08 Summer + 0.17 Autumn
\]

Note: *** denotes significance at the 1 per cent level
Empirical Results

- **Marginal Cost**

Following Brander and Zhang (1990, 1993) and Murakami (2011)

Table 2: Cost per passenger-km of the three airlines (in RMB)

<table>
<thead>
<tr>
<th></th>
<th>CA</th>
<th>CZ</th>
<th>MU</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010_1</td>
<td>0.511</td>
<td>0.540</td>
<td>0.626</td>
</tr>
<tr>
<td>2010_2</td>
<td>0.555</td>
<td>0.556</td>
<td>0.664</td>
</tr>
<tr>
<td>2010_3</td>
<td>0.524</td>
<td>0.539</td>
<td>0.612</td>
</tr>
<tr>
<td>2010_4</td>
<td>0.564</td>
<td>0.614</td>
<td>0.709</td>
</tr>
<tr>
<td>2011_1</td>
<td>0.561</td>
<td>0.580</td>
<td>0.636</td>
</tr>
<tr>
<td>2011_2</td>
<td>0.574</td>
<td>0.632</td>
<td>0.701</td>
</tr>
</tbody>
</table>
Empirical Results

- Conduct Parameter

Table 3: The conduct parameters of dominant airlines on each route

<table>
<thead>
<tr>
<th>Routes</th>
<th>Carriers</th>
<th>2010_1</th>
<th>2010_2</th>
<th>2010_3</th>
<th>2010_4</th>
<th>2011_1</th>
<th>2011_2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing-Shanghai</td>
<td>CA</td>
<td>1.001</td>
<td>1.057</td>
<td>1.262</td>
<td>1.044</td>
<td>0.905</td>
<td>0.915</td>
</tr>
<tr>
<td></td>
<td>MU</td>
<td>0.436</td>
<td>0.559</td>
<td>0.571</td>
<td>0.383</td>
<td>0.450</td>
<td>0.410</td>
</tr>
<tr>
<td>Beijing-Guangzhou</td>
<td>CA</td>
<td>0.851</td>
<td>0.844</td>
<td>0.938</td>
<td>0.895</td>
<td>0.766</td>
<td>0.786</td>
</tr>
<tr>
<td></td>
<td>CZ</td>
<td>0.528</td>
<td>0.611</td>
<td>0.623</td>
<td>0.502</td>
<td>0.561</td>
<td>0.428</td>
</tr>
<tr>
<td>Shanghai-Guangzhou</td>
<td>CZ</td>
<td>0.666</td>
<td>0.896</td>
<td>0.880</td>
<td>0.600</td>
<td>0.551</td>
<td>0.491</td>
</tr>
<tr>
<td></td>
<td>MU</td>
<td>0.328</td>
<td>0.441</td>
<td>0.586</td>
<td>0.170</td>
<td>0.149</td>
<td>0.142</td>
</tr>
</tbody>
</table>
Empirical Results

• **Analysis of the time trend**

A linear time trend model for conduct parameters on each route:

\[ CP = aT + b_1 D_1 + b_2 D_2 + c \]  \hspace{1cm} (4)

- \( CP \) is conduct parameters
- \( T \) is a “time trend” variable with values from 1 to 6
- \( D_1 \) is a dummy variable for the airline,
- \( D_2 \) is a dummy variable with the value 1 for peak season and 0 for off-peak season.
Empirical Results

• Analysis of the time trend

Table 4: Estimated coefficients of the time trend
(Standard errors in parentheses)

<table>
<thead>
<tr>
<th>Routes</th>
<th>Estimates</th>
<th>P-value</th>
<th>R-squared of the model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing-Shanghai</td>
<td>-0.028 (0.015)</td>
<td>0.100</td>
<td>0.941</td>
</tr>
<tr>
<td>Beijing-Guangzhou</td>
<td>-0.020 (0.011)</td>
<td>0.093</td>
<td>0.903</td>
</tr>
<tr>
<td>Shanghai-Guangzhou</td>
<td>-0.064 (0.015)</td>
<td>0.003</td>
<td>0.912</td>
</tr>
</tbody>
</table>
Main conclusions

• The market behavior of Air China is consistent with that described in the Cournot solution.

• Both China Southern Airlines and China Eastern Airlines demonstrate competitive behaviors somewhere between Bertrand and Cournot. However, the former is closer to Cournot, whereas the latter is closer to Bertrand.

• The competition among the three carriers becomes more intense over time.
Future Research

• The impacts of HSR on the Chinese aviation market

• Dynamic behavior in the Chinese airline industry
Thank you!