Market power and its determinants of the Chinese airline industry

Qiong Zhang, Hangjun Yang, Qiang Wang
University of International Business and Economics

Anming Zhang
University of British Columbia

4 June 2013
Introduction

Chinese airline industry’s rapid development

- Annual air passenger traffic has grown by 17% over the last 30 years
- Since 2005, China has become the second largest air transport market in the world (after US)
- According to the forecast by IATA, the Chinese civil aviation market will continue its rapid, albeit at a slower rate, growth in the next 20 years
- Air transport is the fastest growing mode among the three most popular inter-city transport modes in China (road, railway, and air)
Introduction

- Debate on the effectiveness of airline policy reforms

- One view is that the Chinese airline industry has achieved a certain degree of competitive vigor as a result of a steady, in-depth marketization process and proper policy formulation and implementation.

- The contrasting view is that the market-oriented reforms have not effectively weakened the market power of state-owned airlines; consequently, they have not promoted effective competition in the market.
Introduction

- Quantitative measurements of competition and market power
  - Quantitative measurements provide a solid base for rational policy-making
  - However, the rapidly changing environment makes the task difficult to achieve
  - On the one hand, several important and high profit routes have been opened to private airline companies and low-cost carriers (LCCs)
  - On the other hand, corporate reorganization continues to improve competitiveness of the major state-owned airlines
Introduction

- We will first estimate the Lerner indices, which will be used to measure the extent of airline market competition in China.

- Then in the second stage, we investigate the explanatory factors of market power so as to determine the sources of market power.
Literature

- Concentration indicators (e.g. CR, HHI) cannot fully reflect the whole Chinese air transport market (Ma, 2004; Zhang and Round, 2009)
- Lerner index is a better measure of market power (Feinberg, 1980; Yang et al., 2005)
- Lots of applications of the Lerner index (Ariss, 2010; Bosco et al., 2012; Lindquist, 2001; Newbery, 2008; Kutlu and Sickles, 2012)
Definition of Lerner index

\[ L_{ikt} = \frac{p_{ikt} - MC_{ikt}}{p_{ikt}} \]

\( L_{ikt} \) is the Lerner index of carrier \( i \) on route \( k \) in period \( t \)

\( p_{ikt} \) is the per-passenger price of airline \( i \) on route \( k \) in period \( t \)

\( MC_{ikt} \) is the per-passenger cost of airline \( i \) on route \( k \) in period \( t \)

\( L \) ranges from 0 to 1
Larger values of \( L \) indicate stronger market power
Calculating price

Many scholars (Melville, 1998; Alderighi et al., 2012) have used the average price as the price on a route

$$AveP = \frac{\sum_{i=1}^{n} P_i \cdot Num_i}{\sum_{i=1}^{n} Num_i}$$

- $AveP$ is the average price to account for the Lerner index
- $P_i$ is the price of cabin $i$
- $Num_i$ is the number of passengers in cabin $i$
Calculating marginal cost

Brander and Zhang (1990, 1993) proposed an estimation methodology of route-specific marginal cost for each carrier

\[ MC^i_{kt} = cpk_t^i \left( \frac{D_k}{AFL_t^i} \right)^{-\theta} D_k \]

- \( D_k \) is the distance of route \( k \)
- \( AFL_t^i \) is the average distance flown by carrier \( i \) in period \( t \)
- \( cpk_t^i \) is the cost per passenger-km of carrier \( i \) in period \( t \)
- \( \theta \) is an unknown parameter in the cost function that ranges from 0 to 1
Data

- Quarterly route level panel data of the “Big 3” - CA, CZ and MU - in China from 01/01/2010 to 31/12/2011
- A total of 93 routes are analyzed, including the routes among Beijing, Shanghai, and Guangzhou, as well as the non-stop city-pair routes from the three big cities to all provincial capital cities (except Lhasa) and sub-provincial cities
- A total of 1,384 observations are obtained
- Data on airlines’ capacity and the market shares of the “Big 3” on each route are collected from the Civil Aviation Resource Net of China
Data

- Information on number of passengers in different fare classes carried by a given airline on each route is obtained from TravelSky Technology Limited.
- Fare information is obtained from the Chinese Airfare Information Network.
- Data on costs and revenues of carriers are obtained from quarterly and annual reports of Big 3.
- Distances of the routes are collected from Statistical Data on Civil Aviation of China (CAAC, 2012).
- Per capita income, population and GDP of each city are obtained from China City Statistics Yearbook.
Empirical analysis

Steps: First, calculate average price
Second, calculate marginal cost
Last, calculate Lerner index

Table 1: Descriptive statistics of airfares and marginal costs

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC_ind_dist</td>
<td>1,384</td>
<td>0.60</td>
<td>0.36</td>
<td>1.14</td>
<td>0.12</td>
</tr>
<tr>
<td>MC_ind</td>
<td>1,384</td>
<td>788.20</td>
<td>311.52</td>
<td>1,547.51</td>
<td>220.77</td>
</tr>
<tr>
<td>p_ind_dist</td>
<td>1,384</td>
<td>0.75</td>
<td>0.40</td>
<td>2.02</td>
<td>0.20</td>
</tr>
<tr>
<td>p_ind</td>
<td>1,384</td>
<td>990.41</td>
<td>373.25</td>
<td>2,612.90</td>
<td>339.17</td>
</tr>
</tbody>
</table>
Average value of Lerner indices

(a) Upper and lower limits of the 95% confidence interval for the Lerner indices

(b) Lerner indices of the “Big 3” carriers
Differences among the regions

Independent samples t-test among the regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>t value and the level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Eastern region</td>
</tr>
<tr>
<td>Eastern</td>
<td>0.1771</td>
<td></td>
</tr>
<tr>
<td>Central</td>
<td>0.1404</td>
<td>3.306 (0.001)</td>
</tr>
<tr>
<td>Western</td>
<td>0.1775</td>
<td>-0.038 (0.969)</td>
</tr>
<tr>
<td>Northeastern</td>
<td>0.2581</td>
<td>-8.585 (0.000)</td>
</tr>
</tbody>
</table>
Differences among the routes

- Difference test on the market powers among the routes

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>16.05</td>
<td>92</td>
<td>0.17</td>
<td>22.15</td>
<td>0.00</td>
</tr>
<tr>
<td>Within Groups</td>
<td>10.17</td>
<td>1,291</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26.21</td>
<td>1,383</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Determinants of market power

- Route attributes
  - Distance
  - Number of passengers
  - Number of airlines
  - Market share

- Substitutes
  - LCC
  - HSR

- City characteristics
  - Population
  - Income
  - Tourism

- Time differences
  - GDP growth rate
  - Seasonality
Regression model

\[ L_{kt} = \alpha + \beta_1 \ln \text{Distance}_k + \beta_2 \ln \text{Passenger}_k + \beta_3 \text{Share}_k + \beta_4 \text{Number}_k + \delta_1 \ln \text{Population}_k + \delta_2 \ln \text{Income}_k + \delta_3 \ln \text{Tourism}_k + \phi_1 \text{LCC}_k \]
\[ + \phi_2 \text{HSR}_k + \gamma \text{GDPins}_i + \lambda_1 \text{Spring} + \lambda_2 \text{Summer} + \lambda_3 \text{Autumn} \]

\( k = 1, \ldots, 93 \) indicates route identification

\( t = 1, \ldots, 8 \) pertains to the eight seasons starting from 1 January 2010

\( i = 1, 2 \) is the year in lieu of 2010 and 2011, respectively

\( L_{kt} \) is the average of the Lerner index of the “Big 3” on route \( k \)
## Parameter estimation

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>0.030***</td>
<td>0.006</td>
</tr>
<tr>
<td>Passenger</td>
<td>0.008*</td>
<td>0.004</td>
</tr>
<tr>
<td>Share</td>
<td>0.190***</td>
<td>0.032</td>
</tr>
<tr>
<td>Number</td>
<td>-0.011***</td>
<td>0.004</td>
</tr>
<tr>
<td>Population</td>
<td>0.164***</td>
<td>0.038</td>
</tr>
<tr>
<td>Income</td>
<td>0.320***</td>
<td>0.042</td>
</tr>
<tr>
<td>Tourism</td>
<td>0.011*</td>
<td>0.006</td>
</tr>
<tr>
<td>LCC</td>
<td>-0.045***</td>
<td>0.008</td>
</tr>
<tr>
<td>HSR</td>
<td>-0.165***</td>
<td>0.017</td>
</tr>
<tr>
<td>GDPins</td>
<td>0.046***</td>
<td>0.005</td>
</tr>
<tr>
<td>Spring</td>
<td>-0.033***</td>
<td>0.009</td>
</tr>
<tr>
<td>Summer</td>
<td>0.057***</td>
<td>0.008</td>
</tr>
<tr>
<td>Autumn</td>
<td>0.082***</td>
<td>0.008</td>
</tr>
<tr>
<td>cons</td>
<td>-3.176***</td>
<td>0.235</td>
</tr>
<tr>
<td>Wald chi2(13)</td>
<td>680.18</td>
<td></td>
</tr>
</tbody>
</table>
Main conclusions

- A certain degree of market power exists in the Chinese airline industry
- Air China has the strongest market power whereas China Eastern Airlines has the weakest, with China Southern Airlines in the middle
- The northeastern region of China sees the least competition within the domestic market, whereas the central area is the most competitive
- Route distance, population size, income, market share of airlines, and the existence of low-cost carriers and high-speed rail are the main determinants for how competitive the Chinese airline industry is
Policy implications for airlines

- Avoid excessive competition with HSR and try to cooperate with HSR to achieve “win-win” situation
- “Big 3” explore international markets more actively to alleviate the increasingly fierce competition in the domestic market
- Treat different regions differently and implement development strategies suitable for regional economic situation
Policy implications for government

- Improve the connection between airports and HSR stations so as to truly realize the air-HSR service for passengers
- Encourage the entry of LCCs and promote fair competition among airlines, which will lead to better services and lower prices for consumers
- Make full use of comparative advantages of each region
Thank you!