How to Improve the Competitiveness of Chinese Airlines in the World’s Air Cargo Market?

Lulu Hao
Beijing jiaotong university, China
*Corresponding author: Lulu Hao, Master, 18813073686, Email: 237593315@qq.com

Abstract
Chinese airlines and logistics operators play relatively minor roles in the world’s air cargo market. The study researches the air freight network within China using complex network analysis, and identifies the key drivers for the trade volumes which Chinese airline undertake with an augmented gravity model. As a result, GDP, free trade agreement and air network structure have positive effect on it, distance and border have negative effect on it. This should help Chinese airlines to achieve their cargo ambitions in the long time.

Key words: air cargo; air transport network; complex network; gravity equation

1 Introduction
With the rapid development of economic globalization, international trade plays an important role for China’s economic growth. Transportation is essential in international trade, it can realize the spatial transfer of goods.

Since we followed the policy of reform and opening, the trade in goods is booming, the total volume of imports and exports was only 35.5 billion in 1978, but reached 26.4 trillion in 2014, we are the first in the world. In international sales of goods, the mode of transportation are shipping, railway, truck, pipeline and air. Airfreight only accounted for about 0.5% of trade in goods in 2014, but the value was 36%, Chinese airfreight annual growth rate as high as 8.91% in the past decade. Curiously, with the China’s aviation trade in goods rapid growth, the proportion of the Chinese airlines is declining year by year. Why the proportion is declining?

In 1992, Kasarda put forward “the fifth wave theory”, he thought that different mode of transportation would have led the development of economy one after another, after shipping, railway, highway and pipeline, air transport will lead to economy. The development of transportation can make international trade more convenient and efficient, and it can significantly promote the development of a country’s international trade4. The quality of the transport infrastructure, distribution and specialization play an important role for the country’s share in the international trade market5. The improvement of transport infrastructure would reduce transport costs and promote international trade2.

Gong etc shows that China’s air transport network is still a point-to-point network instead of a hub-and-spoke system1. At present, the development of China’s air transport network is
unbalanced, Beijing, Shanghai and Guangzhou are the dominant airport forming a tripod in Chinese domestic air cargo traffic.3

![Fig. 1 - mechanism diagram](image)

**2 Mechanism**

The effect of the transport infrastructures on transport capacity is a worthy research. The increase of new airports and airlines will improve the air transport network. Then it will affect the proportion of Chinese airlines from two respects: apparent and recessive. As shown in Fig. 1, the apparent influence is relatively simple, the improvement of network will improve the capacity of Chinese airlines, then they will provide cheaper transport service and become more competitive. The recessive effect is more complex, the improvement of air network will shorten time and distance and improve accessibility, and then result in economies of
scale, economies of scope and economies of density. Then average transport cost will reduce. Then it will produce externality, the positive externalities are technological advance, workforce and capital agglomeration, the negative externalities are energy consumption, heavily polluted and serious congestion, it will cause the industry agglomeration and specialization, then promote economic growth and improve the proportion of Chinese airlines.

3 Experimental

In the 1960s, Tinbergen first used the trade gravity model, its basic form is:

\[ T_{ij} = kY_iY_j / D_{ij} \]  

Where \( T_{ij} \) is bilateral trade flow between country i and country j, \( Y_i \) and \( Y_j \) are GDPs of the country i and j, \( D_{ij} \) is the distance between country i and country j, \( k \) is the constant. Then more scholars extending the trade gravity model, they research of duties, infrastructure, exchange rate and free trade agreement on the influences of international trade flows. This paper has formulated a trade gravity model which is applied to the research on Chinese air cargo trade, the basic form is:

\[
\ln y_{ij} = \alpha_0 + \alpha_1 \ln GDP_{it} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln D_{ij} + \alpha_4 FTA_i + \alpha_5 BOR + \alpha_6 \ln \beta_{dt} + \alpha_7 \ln \beta_{ft} + \alpha_8 \ln L_{dt} + \alpha_9 \ln L_{ft} + \alpha_{10} C_{dt} + \alpha_{11} C_{ft} + \eta_j
\]  

Where

1. \( y_{ij} \): The trade volumes which Chinese airline undertake between China and country j;
2. \( GDP_{it} \) and \( GDP_{jt} \): GDPs of China and country j;
3. \( D_{ij} \): The distance between China and country j, which reflect transport costs;
4. \( FTA_i \): Dummy variable, it is 1 when there is a FTA in force between the trading partners;
5. \( BOR \): Dummy variable, it is 1 when country j shares a border with China;
6. \( \beta_{dt} \) and \( \beta_{ft} \): The connection rate of the domestic and international air transport network of Chinese airline. It reflects the network complexity, the basic form is:

\[ \beta = \frac{m}{n} \]  

Where \( \beta \) is zero, the network is complete non-communication network; when \( \beta < 1 \), the network is discrete sub-network; when \( \beta > 1 \), the network is loop network. Generally speaking, \( \beta \) is larger, the network is more complex.

7. \( L_{dt} \) and \( L_{ft} \): The average path length of the domestic and international air transport network of Chinese airline, it is defined as the average number of edges along the shortest paths for all
The clustering coefficient of the whole network $C$ is the average of all individual $C_i$'s, the

$$C = \frac{E_i}{k_i(k_i-1)/2}, k_i \geq 2$$

Table 1-Gravity model estimation results for different region

<table>
<thead>
<tr>
<th>Variables</th>
<th>All</th>
<th>Asia</th>
<th>Oceania</th>
<th>Europe</th>
<th>North America</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln GDP_{it}$</td>
<td>0.119 (0.74)</td>
<td>0.103 (0.66)</td>
<td>-5.929 (-1.99)*</td>
<td>0.756 (2.21)**</td>
<td>2.416 (2.21)**</td>
</tr>
<tr>
<td>$\ln GDP_{jt}$</td>
<td>0.044 (4.24)**</td>
<td>0.256 (9.41)***</td>
<td>3.579 (2.62)**</td>
<td>0.203 (1.95)*</td>
<td>1.238 (3.11)***</td>
</tr>
<tr>
<td>$\ln Dis$</td>
<td>-0.363 (-3.97)***</td>
<td>-1.715 (-15.69)***</td>
<td>10.199 (17.0)</td>
<td>-1.963 (-1.94)*</td>
<td>-9.559 (-2.34)***</td>
</tr>
<tr>
<td>$FTA_{it}$</td>
<td>-0.029 (-0.30)***</td>
<td>0.575 (6.61)***</td>
<td>0.252 (0.51)</td>
<td>-0.661 (-1.41)</td>
<td></td>
</tr>
<tr>
<td>$\ln \beta_{dt}$</td>
<td>-1.140 (-11.16)***</td>
<td>-0.489 (-5.12)***</td>
<td>-1.608 (-5.04)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\ln \beta_{ft}$</td>
<td>0.475 (0.718)</td>
<td>-0.788 (-1.25)</td>
<td>16.169 (3.47)***</td>
<td>1.652 (1.94)*</td>
<td>-2.349 (-0.84)</td>
</tr>
<tr>
<td>$\ln L_{dt}$</td>
<td>2.282 (20.28)***</td>
<td>1.665 (12.02)***</td>
<td>-0.862 (-1.10)</td>
<td>2.402 (12.49)***</td>
<td>0.808 (1.24)</td>
</tr>
<tr>
<td>$\ln L_{ft}$</td>
<td>-0.427 (-0.39)***</td>
<td>1.404 (1.97)</td>
<td>-9.612 (-2.89)***</td>
<td>-2.498 (-1.58)</td>
<td>0.854 (0.36)</td>
</tr>
<tr>
<td>$\ln C_{dt}$</td>
<td>0.995 (54.88)***</td>
<td>0.781 (32.01)***</td>
<td>0.658 (8.84)***</td>
<td>1.099 (35.24)***</td>
<td>-0.661 (-1.22)</td>
</tr>
<tr>
<td>$\ln C_{ft}$</td>
<td>-0.129 (-0.82)***</td>
<td>0.087 (0.59)</td>
<td>-0.073 (-0.23)</td>
<td>-0.171 (-0.78)</td>
<td>0.149 (0.89)</td>
</tr>
</tbody>
</table>

The clustering coefficient of the whole network $C$ is the average of all individual $C_i$'s, the
basic form is:

\[ C = \frac{1}{n} \sum_{i=1}^{n} C_{ij}, 0 \leq C \leq 1 \]  

(6)

C is more larger, the more likely nodes are to reach one another within a short topological distance.

4 Empirical analysis

The result of gravity equation is listed in Table 1. As I expected, GDP$_{it}$ and GDP$_{jt}$ have positive effect on the trade volumes which Chinese airline undertake, distance have negative effect on it but Oceania. Free trade agreement have positive effect on the trade volumes which Chinese airline undertake in Asia and Oceania, but have negative effect in Asia. Network structure have positive effect on the trade volumes which Chinese airline undertake.

On the whole, the air transport network in China is developing rapidly, but it’s not enough, we should develop it as soon as possible.

References