A STUDY OF AIRLINE TICKET PRICING IN CHINA

Zhongzhen YANG
Professor
College of Transportation & Logistics
Dalian Maritime University
Dalian, China, 116026
Fax: +86-411-8472-6756
E-mail: yangzhongzhen@263.net

Lu WANG
Doctor Candidate
College of Transportation & Logistics
Dalian Maritime University
Dalian, China, 116026
Fax: +86-411-8472-6756
E-mail: wgjlulu@yahoo.com.cn

Abstract: This paper first theoretically analyzes the current problem of air ticket pricing in China, and investigates the consciousness of travelers on price level with Price Sensitivity Measurement. Secondly, from the perspective of air transports suppliers, optimal air ticket model is built for suppliers benefit increment; and from the perspective of travelers, rational air ticket price model is built for market scale enlargement. With the consideration of different price sensitivity of business and private consumers, this paper distinguishes them. Finally, by taking the flight from Dalian to Beijing as an example, data are collected from questionnaire analysis and optimal air ticket price point and rational price point are estimated with the models, respectively. The results of the example show that current ticket price is higher both for business consumers and for private one, which matches the theoretical analysis. And the numerical test verifies the feasibility and availability of the method.

Key Words: Air ticket price, Price sensitivity measurement, Air transport market scale

1. INTRODUCTION

Chinese air transport market was vendor oriented during 1980-2000, and then has experienced a roughly managed purchaser oriented market since 2000. Currently it is in a detailed subdivision purchaser oriented market and grows quickly. At present, Chinese flight network is extending constantly and the capacity has increased dramatically to enlarge the productivity and the market scale continually. In 2004, turnover of Chinese air transport is about 23 billion ton kilometer, 1.2 billion person trips, and the aircraft hours flown is about 7,700 hours. At the end of 2004, there are totally 1,200 flight lines, and a hub and spoke flight network has formed, in which Beijing, Shanghai and Guangzhou has gradually become the hubs. However, the air ticket pricing is still regulated, which can hardly match up to the rapid development of Chinese air transport industry.

It is well-known that air tickets in China are extremely expensive. In terms of the absolute value, the flight price per kilometer in China is much higher than that in other countries. For example, in the USA, the round-trip ticket for the 25 hours flights between Los Angeles and Beijing is $490, while, in China, the round-trip ticket for the 7 hours flights between Beijing and Urumchi is $460. From the aspect of comparable value, the flight price per kilometer in China is 31 times of that in the USA. Based on the survey, the price of the flight ticket is 10% of the annual per capita income in China, while only 0.5% in the USA. It is obviously that the air transport is still a luxury service in China, many Chinese can not use this service easily thus in some degree, it impedes the growth of Chinese air transport market. Therefore, it is necessary to analyze the Chinese air transport market and its ticket pricing system to find the problems and the solutions, and then offer some theoretical suggestions for the development of Chinese air transport industry.
Wang (2005) discussed the regulations executed on air transport market in several countries. In the USA regulations have been relaxed since 1978. Civil aviation committee of the USA has lost the authority on controlling the flight ticket price in 1983, and airline companies could decide the price through market competition, while the government balanced the prices by the anti-monopoly act. In Canada, the control on the flight ticket price had been loosened since 1979 by carrying out discount administration as the transition, and in 1988 the control was completely removed and at the same time the main airline companies were privatized. Japanese government had gradually lessened the regulation on the market entrance since 1986. In Japan, the government required that an airline should be operated by at least 2-3 companies if the demand was over a certain level and the discount rate is controlled. Since 1995, Japan has relaxed the price regulation and gave the companies a wider discount range. As a result, the actual discount rate was able to be determined by the companies themselves without government intervention. In EU, there is almost no regulation of air fares, it is left to market forces (freedom of price), subject to government intervention only if an airline’s behavior is deemed to be predatory if the cheapest unrestricted fare is ‘unreasonably high’.

While, in China, The executing regulation on airline companies concern three aspects, namely establishment of a company, open air lines and the ticket price making. The price system has experienced the styles of “unified income and expenditure” and “accounts cast respectively” with separating the enterprises function from the authority one. Xiao (2000) thought that the air transport market in China would gradually become a demand oriented one with the domination of the customers. Some others pointed out that the competition in Chinese air transport market is a typical monopolistic one. Liu (2002) concluded that the monopolization in Chinese air transport market is man-made due to the authorize intervention rather than formed by the mark mechanism. Although there are many arguments on the air transport market, the customers are directly affected by the ticket price and many studies widely admitted that the price is the most direct, sensitive and effective measures to adjust the benefits. Xiao (2005) concluded that improper prices would result in the losses of the entire industry. Sun and Zhou (2004) also argued that current planned ticket price faces the market economic system. Therefore, the roles of customers should be taken into account seriously during the pricing process. The pricing system of air transport in China still followed the planned economic system. Although there are already some new reaffirmation or regulation to rectify and reform the price system, they are still not able to matching the rapid development of the market and the price system have not been efficiently improved the market for a long time. Liu (2002) illustrated that the authorized regulations is temporary during the transition and the completely market oriented price would come finally. The authorized regulation and various pricing methods are intensively concerned by the operators and the investigators of airline companies.

This paper focuses on the air ticket pricing in terms of the consumers’ cost-benefit and comparison-competition consciousness, and reference to an identified airline, decides the optimal price which would benefits air transport service supplier, and the rational price which would enlarges the market scale to benefit the passengers.

2. BACKGROUND

Air transport in China has come into its growing stage since 1984 (Yu and Chu, 2004), especially grows most rapidly in the recent 5 years with the total turnover is increasing nearly 17% annually. During this period, a great amount of profit can be obtained just through the
increment of the market scale, i.e. the market scale is most important for both the air transport supplier and the air transport industry. Compared with regional and international markets, domestic air transport market in China is the biggest one with the share of 73.8%. However, the executing authority intervention forms a barrier for the air ticket pricing, and then it is in the way of market scale enlarging. Thus, it aggravates the conflict between the supply and demand, which can be found at the following aspects: the unreasonable using of air resource, the efficiency declining of resource allocation, the obtaining of local stabilization only and the losing of social welfare. The last one can be illustrated through the economics theoretical analyses with Figure 1 as follows:

![Figure 1 Social welfare loses results from authority intervention](image)

As it’s shown in Figure 1, in the completed competitive market, the price is $P_c$ representing the marginal benefit of consumers and the equilibrium output is $Q_c$. In order to enlarge the benefit of suppliers, the price is set as $P_m$, with the authorized intervention in the market, higher than $P_c$, and the equilibrium output will become $Q_m$. Due to the change of price, the decrement of consumer surplus can be illustrated as the area of quadrangle $FKP_m$, and the increment and decrement of producer surplus are the area of quadrangle $FRP_m$ and $RKNT$, respectively. Thus, in total, the loss of social welfare is $FKNT$, which is the net loss of social welfare resulted from the authorized intervention.

Generally, all kinds of transport modes are interrelated and interact on each other. In China, the road and railway transports become the main competitors of air transport. In short distance, expressway is more advantaged due to its convenience, comfort and low cost. In medium distance, because the speed and service have been improved continually, railway obtained some advantages. All of these much affected the air transport. The survival and development of air transport heavily depends on consumers’ behavior. Air transport can only gain more market scale and enhance its competing ability through designing product and offering service based on customers’ demand, changes of market environment, and status of the other transport markets. The customers’ consciousness of the price affects the market scale directly, thus the role and function of customers can not be ignored when pricing.
3. PSM AND SUPPLIER REVENUE

3.1 Price Sensitivity Measurement
The consumers’ expected price for a commodity will be a range rather than an exact point. However, the suppliers often tend to ask “how much would you like to pay”. Due to the question links the price with purchasing intention, the data collected through this kind of questionnaire would be very misleading (Monroe, 1973). Then the question is answered based on the cognized value of the commodity rather than directly on the demand situation. Based on this idea, Westendorp put forth the price sensitivity measurement (PSM) (Rao, 1984), which is developed continuously by the later researchers. Although the investigated data should not be directly used as the final price, it may be used to make a suitable price for a commodity, with combination with other methods.

PSM plots the survey data and does some statistic analysis to find the optimal price ranges with plotted curves. In order to collect the needed data, the surveyed persons are required to answer four questions as follows:

1) What price would you think is expensive?
2) What price would you think is cheap?
3) What price would be too expensive for you to buy or use?
4) What price would be too cheap for you to buy or use since you tend to doubt the quality?

The last question means that consumers would feel that the service level or safety reliability can not be guaranteed under the over-cheap price.

After plotting the collected data, we get Figure 2 and Figure 3. In Figure 2, the point at which the frequency curves of answers of the former two questions meet is IPP (Indifference Price Point), which means that at this point the amount of travelers thinking the price is expensive and that thinking the price is cheap equal each other. Similarly, the point at which the frequency curves of answers of the other two questions meet is OPP (Optimal Price Point), which means that at this point the amount of travelers thinking the price is too expensive and that thinking the price is too cheap equal each other. In Figure 3, the point at which the frequency curves of answers to the second and forth questions meet is PMC (Price of Marginal Cheapness), which means that at this point the amount of the travelers thinking the price is cheap and that thinking the price is too cheap equal each other. The intersection of the frequency curves of the answers to the first and third questions is PME (Price of Marginal Expensive). At this point, the amount of the travelers thinking the price is too expensive and that thinking the price is not expensive equal each other. The area enclosed by the four curves in Figure 3 is the RAP (Range of Acceptable Price) of this airline (Robert, 2000).
After analyzing the surveyed data, the Indifference Price, the Price Stress and the Range of Acceptable Price can be obtained. They interact and determine the price sensitivity together. The price sensitivity depends on the interactions between the Price Stress and the RAP. In a lower price sensitivity market, the Price Stress is narrow while the RAP is large. Whereas if the Price Stress is wide and the RAP is small, the market will be highly sensitive, then much attention should be paid to the pricing. If the customer expected price is out of the RAP, then the suppliers (the price maker) should consider a method to adjust the price to be acceptable. An over high price as a component of the complex market would be wasted effort since it can hardly increase the supplier’s profit but possibly it may make supplier to lose market scale in the future (Lewis and Shoemaker, 1997).

PSM can evaluate the existing price and obtain the optimal price in terms of the consumer’s opinion. It is often used to make the prices of new products or adjust the prices of old products. It can also be used to measure customer’s psychological reflection on existing price of a product or service. Comparing with the “demand-supply relationship pricing”, “cost pricing”, and “competition pricing”, PSM is not only simple and feasible but also pays more attention to the customers. Moreover, it could be used to study customer’s behaviors to the changing price and their acceptable range of the change.

### 3.2 Revenue of air transport supplier

The airline companies and the airport companies are taken as air transport service supplier, and the passengers are the demander. The supplier revenue which depends on the income from air tickets can be represented as follow:

\[
R(x) = x \times S(x)
\]

Here: \( R(x) \) = the revenue of the supplier; 
\( x \) = the air ticket price; 
\( S(x) \) = the market scale of the air transport.

Based on the \( RAP \), the most concerned of the supplier is setting the air ticket price to maximize the revenue. The Figures plotted according to PSM can represent the passengers’ sensitivity to price, however, an optimal price point can not be obtained. Thus, an optimization model is needed to set a price aiming to maximize the revenue. The KLP model (a logit model of PSM made by Kishi (1999)) is consulted as follows.
Here: 
\[ T_n(x) = \frac{1}{1 + \exp(F_n(x))} \]  
\[ T_n'(x) = \frac{1}{1 + \exp(-F_n(x))} \]  

The parameters of \( a_n \) and \( k_n \) in Eq.(4) can be calibrated by the regression between the relative accumulative frequency and the ticket price. With the calibrated results, the relative accumulative frequency at any price point can be obtained. Due to the different sensitivity to the price, the business passengers and private ones are distinguished and represented by subscript \( b \) and \( p \), respectively.

Combined \( F_{b2}(x) \), \( F_{b3}(x) \) with Eq.(1), the business market scale can be represented as Eq. (5), and Eq. (6) for the private market in the same way. Eq. (5) and Eq. (6) are the models for optimizing air ticket pricing in terms of passengers:

\[ S_b(x) = T_{b2}'(x) - T_{b3}(x) \]  
\[ S_p(x) = T_{p1}'(x) - T_{p4}(x) \]  

Here: the price \( x \) is changing within the RAP. Combined with Eq. (1), Eq. (5) and Eq. (6), the model for air ticket pricing in terms of supplier can be obtained. While, any price point, which is beyond RAP is taken as an unreasonable one, is not considered in this study.

4. CASE STUDY

In order to analyze the price of Chinese air ticket, we took the flight from Dalian to Beijing as an example, and carried out the survey to collect data in Dalian airport. Travelers from Dalian to Beijing are asked to answer the questions. Current flight price from Dalian to Beijing is 710RMB+50RMB. Because business and private travelers are sensitive differently to the price, during the survey we make a distinction between them. Totally, 420 questionnaires are distributed and 403 are collected and usable.

Business market is taken as an example, after plotting the collected data, Figure 4 and Figure 5 are gotten. In Figure 4, \( IPP=540\text{yuan} \), which means the amount of travelers thinking the price is expensive and that thinking the price is cheap equal each other when the ticket price is set as 540\text{yuan}; \( OPP=590\text{yuan} \), which means the amount of the travelers thinking the price is too expensive and that thinking the price is too cheap equal each other when the ticket price is set as 590\text{yuan}. In Figure 5, \( PMC=410\text{yuan} \), which means the amount of the travelers thinking the price is cheap and that thinking the price is too cheap equal each other when the ticket price is set as 410\text{yuan}; \( PME=700\text{yuan} \), which means the amount of the travelers thinking the price is too expensive and that thinking the price is not expensive equal each other when the ticket price is set as 700\text{yuan}.
Based on the vertical values of these points, the estimated indicator of the business travelers and private ones are obtained, as shown in Table 1. The Price Stress for the business travelers is 540-590 RMB and the RAP is 410-700 RMB, and for the private travelers, they are 520-550 RMB and 400-670 RMB, respectively.

Table 1 Estimated Indicator for ticket price of Dalian-Beijing Airline

<table>
<thead>
<tr>
<th>IPP</th>
<th>OPP</th>
<th>PMC</th>
<th>PME</th>
</tr>
</thead>
<tbody>
<tr>
<td>540 (B)</td>
<td>520 (P)</td>
<td>590 (B)</td>
<td>550 (P)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price Stress</th>
<th>Range of Acceptable Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>540-590 (B)</td>
<td>520-550 (P)</td>
</tr>
<tr>
<td>410-700 (B)</td>
<td>400-670 (P)</td>
</tr>
</tbody>
</table>

*Note: B= Business    P= Private*

The degree of the price sensitivity may be determined by the acceptable range, thus it can be said that the price sensitivities of both kinds of travelers from Dalian to Beijing are high based on the data analyses. By the comparison, RAP of private travelers is narrower than that of the business ones. This means that the private travelers are more sensitive to the price than the business one.

With the obtained RAP, the revenue of the supplier can be calculated according to Eq. (1). The business market is still taken as the example, the calculation is as follows:

The regression for reply of “not expensive”:

\[ F_{b_1}(x) = -1.821 \times 10^{-2} x + 8.507 \]  \( (t\text{-value} = -36.34) \quad (t\text{-value} = 35.25) \quad (R^2 = 0.974) \)

The regression for reply of “not cheap”:

\[ F_{b_2}(x) = 2.439 \times 10^{-2} x - 14.278 \]  \( (t\text{-value} = -71.21) \quad (t\text{-value} = -58.40) \quad (R^2 = 0.991) \)

The regression for reply of “too expensive”:

\[ F_{b_3}(x) = -1.741 \times 10^{-2} x + 14.048 \]  \( (t\text{-value} = -45.61) \quad (t\text{-value} = 44.58) \quad (R^2 = 0.978) \)
The regression for reply of “too cheap”:

\[ F_{b4}(x) = 2.219 \times 10^{-2} x - 7.314 \]  \hspace{1cm} (10)

\( (t\text{-value} = 57.72) \quad (t\text{-value} = -52.27) \quad (R^2=0.988) \)

Combined Eq. (8) and Eq. (9) with Eq. (2) and Eq. (3), the relative accumulative frequencies of “expensive” and “too expensive” can be calculated as Eq. (11) and Eq. (12), which are taken into Eq. (1) to obtain the revenue from business passengers as Eq. (13):

\[ T_{b2} = \frac{1}{1 + \exp(-2.439 \times 10^{-2} x + 14.278)} \]  \hspace{1cm} (11)

\[ T_{b3} = \frac{1}{1 + \exp(-1.741 \times 10^{-2} x + 14.048)} \]  \hspace{1cm} (12)

\[ R_b(x) = x \times S_b(x) \]
\[ = x \times \left( T_{b2}'(x) - T_{b3}'(x) \right) \]
\[ = x \times \left( \frac{1}{1 + \exp(-2.439 \times 10^{-2} x + 14.278)} - \frac{1}{1 + \exp(-1.741 \times 10^{-2} x + 14.048)} \right) \quad x \in (410,700) \]  \hspace{1cm} (13)

The revenue from private passengers can be calculated in the same way as Eq. (14):

\[ R_p(x) = x \times S_p(x) \]
\[ = x \times \left( T_{p1}'(x) - T_{p4}'(x) \right) \]
\[ = x \times \left( \frac{1}{1 + \exp(1.945 \times 10^{-2} x - 9.029)} - \frac{1}{1 + \exp(2.747 \times 10^{-2} x - 6.917)} \right) \quad x \in (400,670) \]  \hspace{1cm} (14)

Based on Eq. (13) and Eq. (14), Figure 6 illustrates the business market scale, the private one and the supplier revenue from business passengers and that from private passengers changing with different air ticket prices which are within \( RAP \). It can be seen from Figure 6 that the four functions are all with one price point to reach each maximum respectively. In detail, the maximum of business market scale and private one are \((x=640 \text{ yuan}, S_b(x)=81.21\%)\) and \((x=400 \text{ yuan}, S_b(x)=56.45\%)\), respectively. The maximum of supplier revenue from business passengers and from private ones are \((x=650 \text{ yuan}, R_b(x)=525)\) and \((x=400 \text{ yuan}, R_b(x)=225)\), respectively.
It can be read from the above results that the proportion of passengers who choose air mode for a trip reaches 81.21% with the ticket price set on 640 yuan, which represents that the degree of other modes substituting for air mode is weakened and the air market scale is enlarged with a proper ticket price. Taken the business market as an example, from the perspective of passengers, their benefit reaches the maximum with the ticket price set as 640 yuan, and from the perspective of supplier, its benefit reaches the maximum 525 with the ticket price set as 650 yuan.

If the ticket price is set as 400 yuan, the private passengers, with the highest proportion as 56.45%, will choose air mode for a trip, and the supplier revenue will reach its maximum as 225. It should be noted that there is an ascending trend when the ticket price is set below 400 yuan, however, the price less than 400 yuan is not within RAP, and it is not taken as a rational price in this study.

Considering the various influence factors to the ticket price setting, the method in this paper can quickly get the result with the dynamic changing influence factors. Due to the rational consideration of the time consuming, expenses and comfort etc. of all the transport modes, the market scale results is still creditable in spite of no direct consideration of the attributes and competition of all the transport modes in the analysis.

5. CONCLUSIONS

This paper first theoretically analyzes the current problem of air ticket pricing, and investigates the consciousness of the travelers on the price level with Indifference Price Point, Optimal Price Point, Price of Marginal Cheapness, Price of Marginal Expensive, and then Price Stress and Range of Acceptable Price of the air ticket in the Price Sensitivity Measurement. Then, from the perspective of air transports suppliers, optimal air ticket model is built for suppliers benefit increment; and from the perspective of travelers, rational air ticket price model is built for market scale enlargement. With the consideration of different price sensitivity of business consumers and private consumers, this paper distinguishes them. Finally, by taking the flight from Dalian to Beijing as an example, data are collected from the questionnaire analysis and optimal air ticket price point and the rational price point are estimated with the models, respectively. The results of the example show that the current
ticket price is higher both for business consumers and for private one, which matches the theoretical analysis. And the models are well tested. The models consider the ticket pricing problem from both the supply and the demand, respectively. However, how to obtain one price point with attention to both sides, and how to make a price in the market with both business consumers and private one to improve the utility of air resource efficiently are need further study.

REFERENCES