THE NEUTRALITY OF FUEL SURCHARGE

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ABSTRACT

Airline companies usually collect a fuel surcharge rather than increase airfares when fuel prices surge. This paper initiates a theoretical model to analyze the properties of fuel surcharges. We show that the role of fuel surcharges is neutral under the present fee collection scheme, which means that the fuel surcharge policy cannot help the airline industry improve its profits. In addition, the equilibrium results of air fares with fuel surcharge policies are identical to that of the fuel-cost-driven air fares without it. Therefore, the effects on social welfare are the same. We also offer an analysis to clear up the common misunderstanding in which the fuel surcharge policy was in favorable to the airline companies at the expense of the consumer welfare. The empirical facts from Chinese airlines support our theoretical findings.

INTRODUCTION

The growing market demand for Chinese airline transportation (the second largest market in the world) induces airline companies to increase their capacity considerably. Presently, Chinese airline companies are facing great challenges because of the growth of airline capacity and fuel prices. The surging fuel cost is the largest component of the airline companies' operating cost, constituting from 30% in the beginning of 2004 to 40% in June, 2006. In order to release some financial pressure from the fuel cost for airline companies, fuel surcharge policy is implemented in many countries such as U.S., Canada and China.

However, in China, the refined oil price is under government control, and the airline companies are mostly state-owned. For this reason, fuel surcharge policy has aroused violent public reaction and academic debates. The key controversies are: why there is co-existence of fuel surcharges and discounted airline tickets in the market and whether fuel surcharge policy is fiscal subsidy in favor of the airline companies at the expense of the consumer welfare.

We show in this paper that when airline market is competitive, surging fuel costs will drive up air fares. The role of fuel surcharge is neutral. That is, the same equilibrium will be achieved with or without fuel surcharge policy. The social welfare results are the same.

The structure of the paper is as follow: The first part is an introduction of the implementation of fuel surcharge policy and the objectives of this paper. In the second part, we theoretically analyze the market structure of the Chinese airline industry. This theoretical framework supports further discussion about the impact of fuel surcharge on the air fares, and the impact on social welfare. The third part is empirical facts of the Chinese fuel surcharge policy based on the theoretical model, which is consistent with our theoretical findings, thereby enabling us to identify the current fuel surcharge policy. The conclusions of this paper are in the fourth part. We propose some policy suggestions in the fifth part.

LITERATURE REVIEW

In developed countries, regulation policy is an important issue in the airline industry receiving considerable attention by economists. A substantial volume of research has been devoted to verifying and understanding the efficiency of government policy in airline industry. Douglas and Miller (1974) showed

that when the CAB (Civil Aeronautics Board) implements the regulation policy on the airline market, the regulators can indirectly control the quality by the selection of the price parameter.

Borenstein (1989) believed that the market power of an airline company relies on its control over airline routes and airports. An airline company's control over a fixed airline route and airports immediately determines its power over the Revenue Passenger Miles (RPM). Abramowitz and Brown (1993) investigated the relationships between air fairs and crowdedness, consumer preference of airline brands, entry costs and the number of airports in a city. The conclusion is that the American airline industry market is not competitive; rather, some fundamental factors could determine the monopoly power of airline companies. Borenstein and Rose (1994) first studied price discrimination on the same route, and connected it with market structure, especially market concentration. They found that the more competition exists the more price discrimination also exists. Similar results can be found in Hayes and Ross (1988) and Stavins (2001) using different data.

Borendten and Rose (1995) tested the impact of financial constraints on pricing in the American airline industry. They showed that bankruptcy effects have no impact on pricing behavior, yet because of financial constraints, airline companies are forced to choose lower ticket prices. Busse (2002) found that those financially-distressed companies prefer to start price wars more frequently. Peteraf (1995) considered the sunk cost in monopoly airline market and the impact of potential competitors on the pricing policies of airline companies. She found no proof to show that airline industry market is competitive, and that the sunk cost would have no effect on monopoly pricing. The key factors are potential entry cost and the reputation of discount decision. Although there is economy of scales in the airline market, it is still not competitive. Alam, Ross and Sickles (2001) studied pricing strategies and their effects on airline market efficiency using time series. Their evidences show that dynamic and competitive pricing policies do exist based on different structures of the air fares.

However, none of the existing literature studied the efficiency of fuel surcharge policy and its social welfare impact. We show in this paper that when airline market is competitive, the role of fuel surcharge is neutral. That is, the same equilibrium will be achieved with or without fuel surcharge policy. The social welfare results are the same.

BASIC FRAMEWORK

We will analyze Chinese airline market structure based on our theoretical framework and outline the strategic reaction of airline companies faced with external shock (surging fuel price). Gong and Fan (2006) indicate that Chinese airline market is competitive in recent years. We will analyze the impact of rising fuel cost on airline industry and the effects of fuel surcharge on air fares.

We assume that there are *n* airline companies in the airline market. Let q_i be the transportation quantity (total transportation quantity of passengers and goods) of the airline company *i*, and $Q = \sum_{i=1} q_i = q_1 + q_2 + ... + q_n$ be the total transportation quantity of the airline market, p is the market clearing ticket price. Assume that the consumers in the market are rational, the inverse-demand function of the market is

$$p(Q) = a - bQ . \quad (1)$$

When there is fuel surcharge, let p' be the nominal ticket price of the airline companies; and let A be the fuel surcharge on each passenger. Thus the air fares in the market are composed of two parts: $p = p' + A$,

where *p* is the total payment of consumers. The inverse demand function for ticket price p' in the market becomes

$$p'(Q) = a - A - bQ \tag{2}$$

Assume that each airline company has the same cost function $C_i(q_i) = K + (c_0 + c_1)q_i$, *K* is the initial entry cost for airline companies; c_0 is all unit variable cost in the actual operation of airline companies excluding the fuel cost. c_1 is the unit fuel cost; $(c_0 + c_1)$ is the unit variable costs for airline companies. A necessary condition for the survival of airline companies is $(c_0 + c_1) \le a$.

Gong and Fan (2006) have showed that present Chinese airline market is competitive. Airline companies compete with each other. Hence, each airline company maximizes its own profit. We first consider the case that there is no fuel surcharge. The profit maximization problem for company *i* is as following:

$$\max_{q_i} \pi_i = pq_i - (c_0 + c_1)q_i - K \tag{3}$$

s.t. $$p(Q) = a - bQ \tag{1}$$

We could solve each airline company's optimal transportation quantity: $q^*_{i\,o} = \dfrac{a - c_0 - c_1}{b(n+1)}$ (We use lower o to indicate all results without fuel surcharge), the whole airline industry's transportation volume: $Q^*_o = \dfrac{n(a - c_0 - c_1)}{b(n+1)}$, the equilibrium ticket price in the airline market is

$p^*_o = \dfrac{a}{n+1} + \dfrac{nc_0}{n+1} + \dfrac{nc_1}{n+1}$, and thus, each airline company's profit is $\pi_{io} = \dfrac{[a - (c_0 + c_1)]^2}{b(n+1)^2} - K$.

The results of the model show that in a competitive market, the equilibrium ticket price p^*_o (the total payment of consumers) depends on four variables: market demand, number of airline companies in the transportation market n, variable costs except for the fuel cost c_0 and the fuel cost c_1.

If the other three variables remain same, when the fuel cost c_1 rises, inevitably the equilibrium air fares in the airline market will go up. Consumers will have to pay more, but the profit of airline companies will go down because of less customers and higher fuel cost. That is:

$$\frac{dp^*_o}{dc_1} = \frac{n}{n+1} > 0 \tag{4}$$

and

$$\frac{d\pi_o}{dc_1} = -\frac{2[a - (c_0 + c_1)]}{b(n+1)^2} < 0 \tag{5}$$

Therefore, the surge of fuel cost necessarily results in loss of both the consumer's surplus and airline companies' profit, hence lowers the social welfare. The amount of loss depends on the degree of competition in the airline market ($\frac{n}{n+1}$), the market demand and elasticity (change of a and b), etc.

Fuel Surcharge Policy

In a competitive market, if the increased fuel surcharge goes directly into airline companies' business income, then the total payment of consumers including fuel surcharge will be $p = p' + A$, where p' is nominal ticket price and A is fuel surcharge. Hence the inverse demand function will become $p'(Q) = a - bQ - A$. We claim that the total payment of consumers with fuel surcharge policy should be as the same as that without fuel surcharge policy where the airline companies directly raise their ticket price p. That is called the neutrality of fuel surcharge. We provide analysis as following:

When there is fuel surcharge, the airline companies maximize their profit considering fuel surcharge income:

$$\max_{q_i} \pi_i = p' q_i - (c_0 + c_1) q_i + A q_i - K \quad (6)$$

s.t. $$p'(Q) = a - bQ - A \quad (7)$$

The optimal transportation volume for each airline company is $q^*_{i\,\mathrm{s}} = \frac{a - c_0 - c_1}{b(n+1)}$ (we use lower s to indicate all results with fuel surcharge), and the whole airline industry's transportation volume is: $Q^*_{\mathrm{s}} = \frac{n(a - c_0 - c_1)}{b(n+1)}$, the total payment of consumers in equilibrium is:

$p^*_{\mathrm{s}} = \frac{a}{n+1} + \frac{nc_0}{n+1} + \frac{nc_1}{n+1}$, the nominal ticket price in the market is:

$p'^*_{\mathrm{s}} = \frac{a}{n+1} + \frac{nc_0}{n+1} + \frac{nc_1}{n+1} - A$. Then, the profit of each airline company is:

$\pi_{i\mathrm{s}} = \frac{[a - (c_0 + c_1)]^2}{b(n+1)^2} - K$.

From the results of our model, we know that $p^*_{\mathrm{o}} = p^*_{\mathrm{s}} = p'^*_{\mathrm{s}} + A = \frac{a}{n+1} + \frac{nc_0}{n+1} + \frac{nc_1}{n+1}$. The total payment of consumers and market supply are independent from the air fares structure in equilibrium.

A Common Misunderstanding

The model analyses above shows that in a competitive airline market, a rise in fuel costs immediately results in a rise of air fares. Fuel surcharge is neutral, which means, with or without fuel surcharge policy, the consumers' real payments are the same.

Nevertheless, in the present airline market, public opinions usually regard fuel surcharge policy as governmental intervention in favor of the airline companies at the expense of the social welfare. The key reason of this misunderstanding is the mechanism of fuel surcharge collection.

People usually take fuel surcharge collected by airline companies as fuel taxation (in the form of specific tax levy), a governmental subsidy for the airline companies (tax transfer payments). Of course in this situation, fuel surcharge becomes one-time governmental subsidy to the airline companies in order to compensate for those companies' loss from the increasing fuel costs. Thus, the profit maximization problem for airline company *i* becomes:

$$\max_{q_i} \pi_{i\text{subsi dy}} = p'q_i - (c_0 + c_1)q_i + Aq^*_i - K \tag{8}$$

s.t. $$p'(Q) = a - bQ - A \tag{9}$$

where Aq^*_i is the taxation transfer from government which comes from fuel surcharge. Consequently, each airline company's optimal transportation volume is: $q^*_{i\text{ subsi dy}} = \dfrac{a - c_0 - c_1 - A}{b(n+1)}$ (we use lower *subsidy* to indicate all results in this case), and the whole airline industry's transportation volume is: $Q^*_{\text{subsi dy}} = \dfrac{n(a - c_0 - c_1 - A)}{b(n+1)}$, the nominal ticket price in equilibrium is:

$p'^*_{\text{subsi dy}} = \dfrac{a}{n+1} + \dfrac{nc_0}{n+1} + \dfrac{nc_1}{n+1} - \dfrac{A}{n+1}$, and the real payment of consumers is:

$p^*_{\text{subsi dy}} = \dfrac{a}{n+1} + \dfrac{nc_0}{n+1} + \dfrac{nc_1}{n+1} + \dfrac{nA}{n+1}$.

If a fuel surcharge is collected in the form of tax transfer payments, then the total payment of consumers is higher than the total payment without fuel surcharge:

$$p^*_{\text{subsi dy}} = \frac{a}{n+1} + \frac{nc_0}{n+1} + \frac{nc_1}{n+1} + \frac{nA}{n+1} > p^*_{\text{o}} = \frac{a}{n+1} + \frac{nc_0}{n+1} + \frac{nc_1}{n+1}. \tag{10}$$

There would be an additional $\dfrac{nA}{n+1}$ surcharge in the payment of consumers. Hence this kind of taxation subsidy will damage consumer's surplus. In addition, the market equilibrium volume will be less than that without fuel surcharge. i.e.

$$Q^*_{\text{subsi dy}} = \frac{n(a - c_0 - c_1 - A)}{b(n+1)} < Q^*_{\text{o}} = \frac{n(a - c_0 - c_1)}{b(n+1)} \tag{11}$$

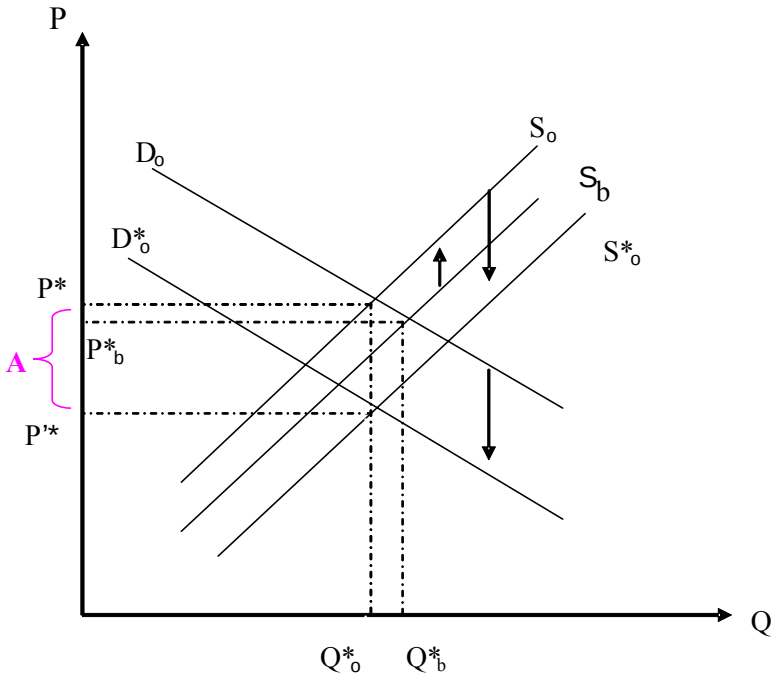
Hence the social welfare decreases in this situation. Furthermore, the profit of each airline company is: $\pi_{i\text{subsi dy}} = \dfrac{[a - (c_0 + c_1) + nA][a - (c_0 + c_1) - A]}{b(n+1)^2} - K$, which is higher than that without fuel surcharge: $\pi_{i\text{s}} = \dfrac{[a - (c_0 + c_1)]^2}{b(n+1)^2} - K$.

This model shows that fuel surcharge taxation policy can be considered a governmental administration intervention. It facilitates airline companies' collusion to acquire monopoly profit. Consequently, this taxation fuel surcharge will damage consumer surplus and social welfare.

Social Welfare

We analyze the social welfare of fuel surcharge policy above as following:

Figure 1: Social welfare analysis when fuel surcharge is collected as airline company income

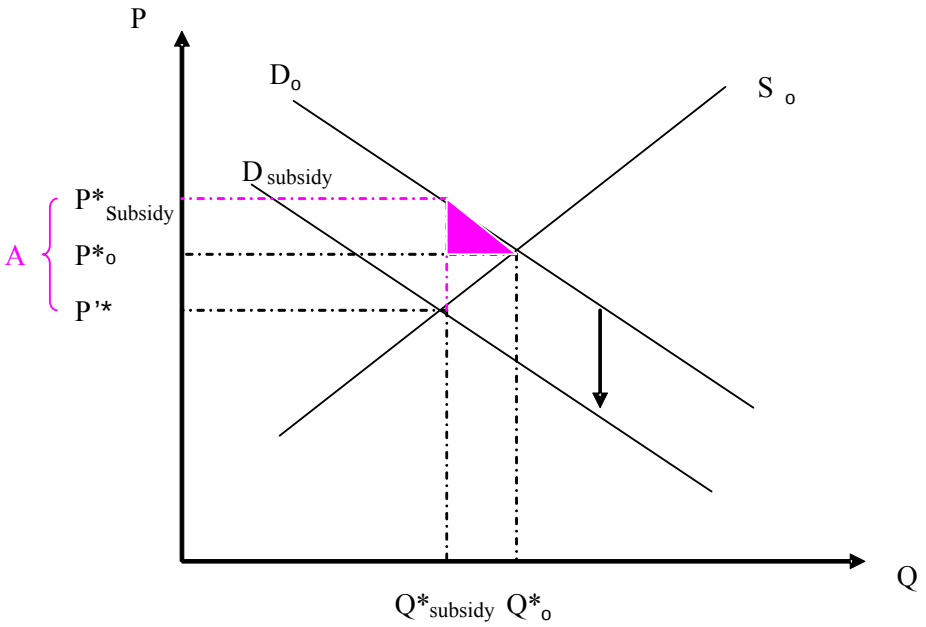


If fuel surcharge is government "tax transfer payments", for each airline ticket, a form of "fuel tax" is charged, and the market demand goes down; at the same time, the lump sum fuel surcharge is transferred to the airline companies and does not change their variable cost, hence the market supply remains the same, or the supply curve remains unchanged. Therefore, both the market transportation volume and price fall in equilibrium. Nevertheless, the total payment of consumers is the sum of equilibrium price and the fuel surcharge. Therefore, $P_{\text{subsi dy}} > P_o$. In this way, airline companies use fuel surcharge to raise the real air fares. Fuel surcharge in this way helps the realization of "price collusion" among the airline companies, by means of indirect governmental administrative power rather than spontaneous market power. Hence, not only the consumer surplus but also the social welfare is damaged. The lost social welfare is shown in the shadow area in Chart 2. The only winners are the airline companies who gain more profit.

EMPIRICAL FACTS

We know from our theoretical analysis above that rising fuel costs necessarily increase the total air fares, which is determined by the competitive market structure of Chinese airline industry. Under competitive market structure, the equilibrium results of the air fares with fuel surcharge policy are identical to that of the fuel-cost-driven air fares without fuel surcharge policy. Hence, whether to implement fuel surcharge policy has no effects on the Revenue Passenger Miles of the airline companies. Whereas if the fuel surcharge is a way of "fuel tax", airline companies will profit from that and the fuel surcharge will change the passenger kilometer income level.

Figure 2: Social welfare analysis when fuel surcharge is collected as "tax transfer payments"



We adopted the financial data of a large Chinese airline company to conduct empirical analysis. We selected production volume and financial data from January, 2004 to June, 2006. From the production data, we see that the transportation quantity of this airline company is growing steadily, Passenger Load Factor (PLF), remained stable, which shows that the airline market demand rose gently, independent from external factors (see Figure 3).

Here is an intuitive analysis of this airline company's financial data. General Administration of Civil Aviation of China started collection of fuel surcharge from August, 2005. Therefore, from the airline company's financial report, we can separately list real income and fuel surcharge income, thus we can calculate Revenue Passenger Miles (RPMs "including fuel surcharge" and "excluding fuel surcharge" Through comparison of different Revenue Passenger Miles (RPMs) in different time periods, we can eliminate the influence of seasonal factors while also having the effects of fuel surcharge. From August, 2004 to June, 2005, Revenue Passenger Miles (RPMs) on average "excluding fuel surcharge" is RMB$0.602/passenger kilometer, square deviation being 0.002; from August, 2005 to June, 2006, passenger kilometer income on average "including fuel surcharge" is RMB$0.610/passenger kilometer, square deviation being 0.002; over the same period, the Revenue Passenger Miles (RPMs)on average "excluding fuel surcharge" is RMB0.581/passenger kilometer, square deviation being 0.002. These results are consistent with our theoretical analysis, i.e. rising fuel cost increases average airfare. Even though the RPMs excluding fuel surcharge decreased, which means that the nominal ticket price decreased, it is compensated by fuel surcharge income. The total payment of consumers increased (See Figure 4).

Figure 3: Monthly Passenger Transportation Volume and Passenger Load Factor Level

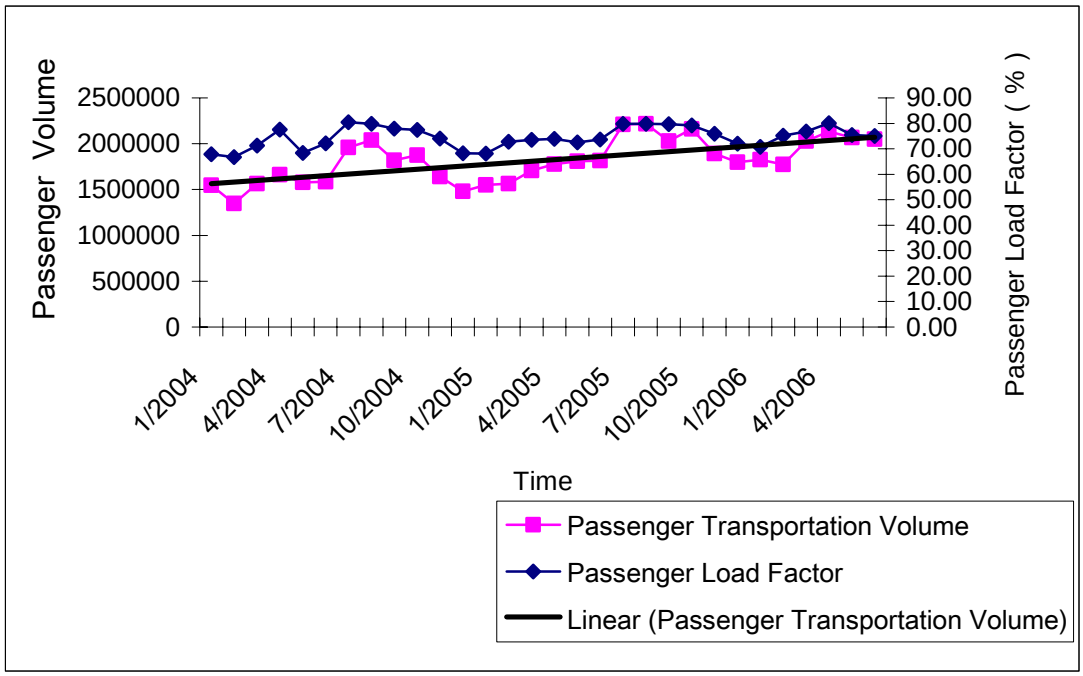
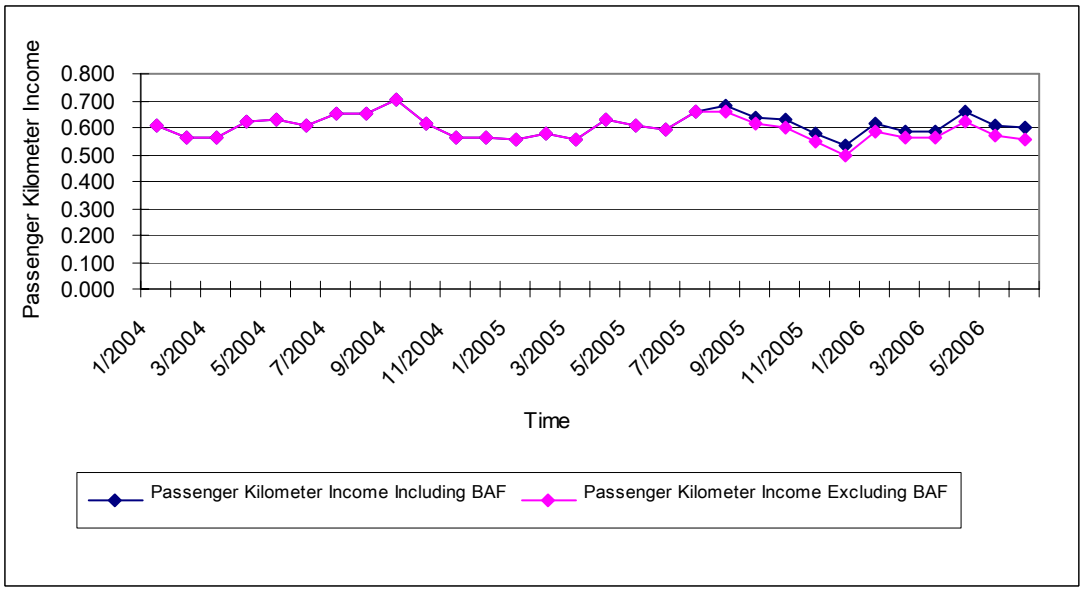


Figure 4: Passenger Kilometer Income of Some Big Airline Companies



CONCLUSIONS AND POLICY IMPLICATIONS

We show in this paper that when airline market is competitive, surging fuel costs will drive up air fares. The role of fuel surcharge is neutral. The same equilibrium will be achieved with or without fuel surcharge policy. The social welfare results are the same. We also offer an analysis to clear up the common misunderstanding in which the fuel surcharge policy is assumed to be in favor of the airline companies at the expense of the consumer welfare.

The Chinese government uses fuel surcharge policy to subsidize the airline companies. If the fuel surcharge is taxed the same as ticket income of airline companies, due to the neutrality of fuel surcharge, the results of fuel surcharge policy are equivalent to those without fuel surcharge policy in equilibrium. Therefore, fuel surcharge policy will have no effect of subsidizing airline companies but will incur lots of institutional cost and public discourse. In conclusion, in order to reduce the risk of fuel price fluctuation, the corporate income tax on the fuel surcharge should be exempted.

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