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Full Length Research Paper

Optimum channel strategy for air ticketing

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This paper focuses on air ticketing in a duopoly market. The games with three different channel structures, including the integrated structure (selling tickets through company channels), common franchisee structure (selling tickets through a common franchisee), and decentralized franchisee structure (selling tickets through different franchisees), are modeled to explore the optimum channel strategy for airline companies in various competition situations and high/low seasons. These game models are built based on Trivedi's linear demand function including air ticket and franchisees competitions. Findings suggest that the integrated structure is the optimum channel choice for airline companies in most situations. However, if there is intense competition between franchisees and between tickets, and the season is favorable to the aviation industry, the decentralized franchisee structure is the optimum channel choice for airline companies.

Key words: Air ticketing, duopoly, channel strategy selection, game model.

INTRODUCTION

The recent oil price surge has increased the operational costs of airline companies, forcing many of them to seek effective channel strategies and customer contact opportunities to boost their ticket sales and profits. Selling out all available tickets is an imperative task for all airline companies. Unlike general tangible commodities or services which are produced and consumed at the same time or in the same space, air tickets will be completely wasted if they become inventory. A vacant seat in a flight means a loss to the company. Therefore, all airline companies must manage to sell out all available tickets within their valid dates.

Air ticket franchisees (for example, ticketing center or travel agency) are one of the important channels that airline companies rely on to sell their tickets. These franchisees usually buy blocks of airline seat inventory from airline companies at discount rates (that is, wholesale prices). The rates are determined by the airline companies according to market conditions and the size of the blocks. The tickets sold through this channel are called consolidated tickets. Airline companies used to have a high level of reliance on franchisees. In order to survive the economic recession, they had to work with franchisees to increase their sales in the market. Some of them even allocated a portion of their resources to this business (for example, providing itinerary planning service to travelers).

Like most industries, the aviation industry has both high and low seasons. In high seasons, franchisees expect airline companies to offer more tickets to satisfy market demands. In low seasons, airline companies expect franchisees to buy more tickets to share the costs of vacant seats.

The channel structures formed by airline companies and franchisees have certain impacts on air ticket sales. Early research of channel strategy focused on single channels. Researchers applied Stackelberg's game theory and cooperative games to analyze the optimum channel strategies for markets with the manufacturer as the leader, the retailer as the leader, and the manufacturer and the retailer in cooperation. However, competition was ignored in the single-channel research. Therefore, later researchers included competitors in their research model and analyzed the optimum channel

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strategy in a duopoly environment. Recent research paid more attention to the situation with two competing manufacturers, each selling its products through an independent retailer. Several different channel structures have been proposed for this market environment. For instance, McGuire and Staelin (1983) proposed three channel structures, namely pure integrated structure, pure decentralized structure, and mixed structure, and derived a demand function including product competitions. Most subsequent research either adopted the same structures or demand function, or extended the function to model the channel choice. Choi (1991), for example, proposed a demand function that captures product differentiation based on the function derived by McGuire and Staelin (1983). Trivedi (1998) further extended this function by including competition between retailers.

These studies investigated the optimum channel strategy based on the relationship between manufacturers and retailers. Considering that the marketing costs of most products are borne by their manufacturers, previous research usually incorporated marketing costs into the manufacturer's profit function. In the aviation industry, airline companies do not need to bear marketing costs if they sell their tickets through franchisees. In light of the importance of channel selection for airline companies and the fact that the extant game models may not be fully applicable to the aviation industry, this paper will build game models for several different channel structures to determine the optimum channel strategy for each structure on the condition of maximum profit. To simplify the analysis procedure, this paper considers three different channel structures in a duopoly market. The first structure is where airline companies sell tickets all by themselves; the second is where two airline companies sell tickets through one common franchisee; the third is where two airline companies sell tickets through different franchisees. Besides, it is assumed that in high tour seasons, airline companies are leaders and franchisees are followers; in low seasons, franchisees are leaders and airline companies are followers.

RELATED RESEARCH

Channel strategies for the structure with one manufacturer and one retailer

Early research of channel strategy focused mainly on the channel structure with one manufacturer and one retailer and assumed the manufacturer and the retailer are independent decision-making units (Jeuland and Shugan, 1983). As stated in textbooks, selling products through retail channels reduces the manufacturer's profit but can increase the exposure of the products to customers. This is why the majority of manufacturers will choose to sell their products through retailers. In the channel structure with one manufacturer and one retailer, vertical integration is a strategy that can help all members make maximum profits. However, members in this structure are usually unwilling to share information and resources, so there is little incentive for them to cooperate with each other. Besides, most channel structures in the market involve multiple manufacturers. In this multi-manufacturer environment, manufacturers have to take into account product competition in the selection of channel strategy, so, vertical integration may not necessarily be the optimum channel strategy.

Product competition

McGuire and Staelin (1983) were the first to include product competition (product substitutability) in the model of factors affecting channel choice. They explored the optimal channel strategy for two manufacturers in a duopoly in three different channel structures, namely the pure integrated structure, the pure decentralized structure, and the mixed structure. Their findings suggested that for more highly competitive goods, manufacturers would distribute their products through retailers to reduce the effects of intense price competition on them; for goods with low degrees of substitutability, manufacturers would distribute products through their own channels since the buffer effect of retailers has subsided.

Based on these three channel structures, Moorthy (1988) investigated the effect of strategic interaction between two manufacturers on their channel-structure selection. Their findings revealed that if there was no strategic interaction (strategic substitutability/ strategic complementarity), the manufacturers would prefer the pure integrated structure; with strategic interactions, the manufacturers would prefer the pure decentralized structure. However, distributing products through franchised channels to raise the demand and profits can happen only if one of the following conditions is satisfied: (1) the manufacturers' products are demand substitutes at the retail level and strategic complements at the manufacturer or retail levels. In other words, when one manufacturer (retailer) reduces a product's price to increase its demand, the other manufacturer (retailer) will reduce the product's price as well. (2) The manufacturers' products are demand complements at the retail level and strategic substitutes at the manufacturer or retailer levels. That is to say, when one manufacturer (retailer) reduces a product's price to increase its sales, the other manufacturer (retailer) will raise the product's price to increase his profits. Moorthy (1998) thus concluded that manufacturers' adoption of the pure decentralized structure is a decision dependent on both strategy and demand.

Taking into account the effects of channel power, Choi (1991) analyzed channel selection in the structure with two competing manufacturers and one common retailer. Following McGuire and Staelin (1983) and Jeuland and Shugan (1983), Choi (1991) built a demand function including production differentiation and investigated three different power structures between the two manufacturers and the retailer, that is, manufacturer Stackelberg, retailer Stackelberg, and vertical Nash. It was found that (1) as products were less differentiated, all channel members' prices and profits would increase; exclusive dealer is the optimum channel strategy for manufacturers; (2) as products were more differentiated, common retailer became the optimum strategy for manufacturers. Besides, if the demand function was nonlinear and products were highly differentiated, manufacturers could get more profits by using an exclusive dealer strategy than by using a common retailer strategy.

Store differentiation

Choi (1996) further analyzed price competition in a duopoly common retailer channel structure using a demand function extended from those proposed by Coughlan and Lal (1990) and Raju et al. (1994). This extended function captured both product differentiation and store differentiation. Findings suggested that equilibrium prices can be higher when products and stores are differentiated. Besides, product differentiation can boost the profits of manufacturers, and store differentiation can boost the profits of retailers. In other words, product differentiation helps manufacturers but hurts retailers; store differentiation hurts manufacturers but helps retailers. Therefore, only adequate use of product and store differentiation can create a win-win situation for both manufacturers and retailers.

In addition to channel power and product substitutability, Trivedi (1998) added "store substitutability" into the demand function proposed by McGuire and Staelin (1983) to analyze three non-cooperative games with two different power structures between two manufacturers and two retailers. Trivedi (1998) indicated competitive effects at both retail and manufacturer levels of distribution have a significant impact on profits and prices. Under equilibrium conditions, channel members at high competitive levels will lose more channel power. If the competition between products is low and that between retailers is high, a "full channel" strategy is more advantageous to manufacturers; if the competition between products is high and that between retailers is low, the full channel strategy becomes more advantageous to retailers.

PROFIT MODEL AND EQUILIBRIUM CONDITIONS

Notations

q_j denotes the quantity of tickets that airline company j sells by itself $(j=1,2)$.

q_{ij} denotes the quantity of tickets that airline company j sells through franchisee i $(i=1,2;\ j=1,2)$.

p_j denotes the retail price of airline company j's tickets sold by the company itself $(j=1,2)$.

p_{ij} denotes the retail price of airline company j's tickets sold by franchisee i $(i=1,2;\ j=1,2)$.

w_{ij} denotes the wholesale price of tickets that airline company j has set for franchisee i $(i=1,2;\ j=1,2)$.

r_j denotes the marketing costs borne by airline company j $(j=1,2)$.

r_{ij} denotes the marketing costs borne by franchisee i for the tickets of airline company j $(i=1,2;\ j=1,2)$.

m_{ij} denotes the retail margin requested by franchisee i on the tickets of airline company j $(i=1,2;\ j=1,2)$.

π_j denotes the profit of airline company j $(j=1,2)$.

π_{Ri} denotes the profit of franchisee i $(i=1,2)$.

θ denotes the level of competition between the two airline companies' tickets.

χ denotes the level of competition between the two franchisees.

Demand function

The demand function used in this paper is based on Trivedi's (1998) demand function, which can be expressed as follows:

$$q_{ij}=1-(p_{ij}-\sqrt{r_{ij}})+(1-\theta)\chi(p_{kj}-\sqrt{r_{kj}})+\theta(1-\chi)(p_{il}-\sqrt{r_{il}})+\theta\chi(p_{kl}-\sqrt{r_{kl}})$$
$$(i=1,2;\ j=1,2;\ k=3-i;\ l=3-j) \quad (1)$$

where θ and χ respectively denote the competitive level between products and the competitive level between franchisees. Given a franchisee selling two competitive products, θ is a ratio between change in the sales of the competing product and change in the sales of the existing product when both products' prices have been changed. θ can be represented as in Equation 2:

$$\theta=-\frac{\partial q_{ij}/\partial p_{ij}}{\partial q_{ij'}/p_{ij'}} \quad (2)$$

In Equation 2, j and j' respectively denote the products of the two airline companies, and i denotes the franchisee selling the two products. θ ranges between 0 and 1. A θ value close to 1 indicates the two products have a high degree of substitutability and can be viewed as substitute products. For consumers, the two products offer the same utility. A θ value close to 0 indicates the two products are mutually independent and can be viewed as independent products. They provide different utilities to consumers, so their manufacturers are all monopolists.

χ denotes the difference between the services provided by the two franchisees. Given two competing franchisees selling the same product, χ is a ratio between change in the sales volume of the competing product and change in the sales volume of the existing product when the retail prices of both products have been changed. χ can be represented by Equation 3:

$$\chi=-\frac{\partial q_{i'j}/\partial p_{ij}}{\partial q_{i'j}/p_{i'j}} \quad (3)$$

In Equation 3, i and i' represent two retailers selling the same products. χ ranges between 0 and 1. A χ value close to 1 indicates that the two retailers provide nearly the same services to consumers and can be viewed as highly substitutable. A χ value

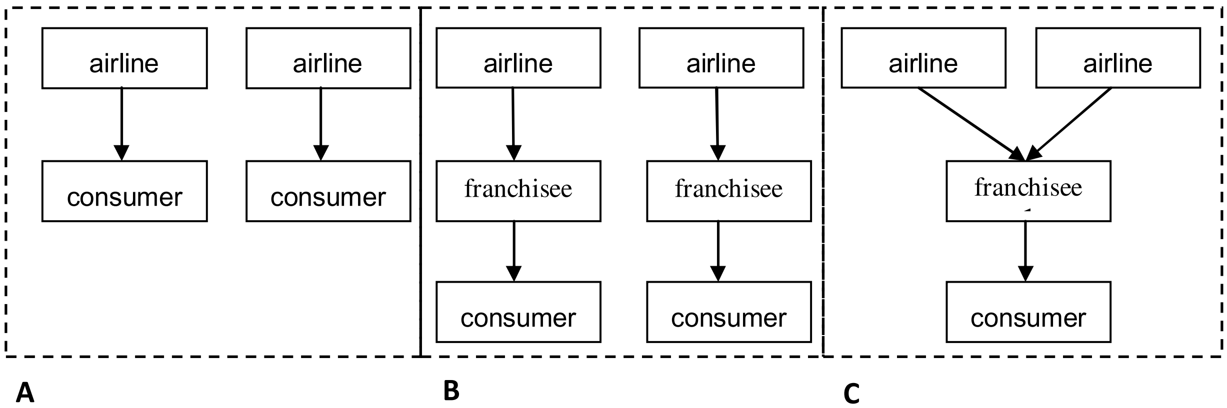


Figure 1. The channel structures studied in this paper.

near 0 indicates that the two retailers offer different services to consumers. In this case, customers will develop loyalty to specific retailers.

Although marketing costs are positively related to sales volume, investment and marketing outcome are not entirely in a linear relationship. The effects of investment in marketing will gradually decrease. Thus, $r_{ij}^{1/2}$ is used to represent the effects of marketing costs on sales volume in Equation 1.

Profit and equilibrium in the three channel structures

Here and subsequently, *I* represents the "integrated channel structure" in which two airline companies sell tickets through their own channels; *CAS* represents "common airline Stackelberg", in which two airline companies sell tickets through a common franchisee and have dominance over the channel; *CFS* represents "common franchisee Stackelberg", in which two airline companies sell tickets through a common franchisee, and the franchisee has the leadership; *DAS* represents "decentralized airline Stackelberg", in which two airline companies sell tickets through two different franchisees and have the leadership; *DFS* represents "decentralized franchisee Stackelberg", in which two airline companies sell tickets through two different franchisees, and the franchisees have the leadership.

The profit model and equilibrium in the case of two airline companies selling tickets all through their own channels

When the two airline companies sell their tickets by themselves (Figure 1a), they have to assume all the marketing costs. The profit function for them is as follows:

$$\pi_j = p_j q_j - r_j \quad (j=1,2) \tag{4}$$

According to Equation 3, each company's ticket sales can be represented by:

$$q_j = 1-(p_j - \sqrt{r_j}) + (1-\theta)\chi(p_k - \sqrt{r_k}) \quad (j=1,2; k=3-i) \tag{5}$$

To simplify the calculation, we let and take the first-order derivative of the retail price and marketing cost to obtain the first order condition for maximum profits of the airline companies. By solving the simultaneous equations, we can get the equilibrium retail prices and marketing costs in this channel structure. Finally, we can bring the retail prices and marketing costs into the demand function (Equation 5) and the profit function (Equation 4) to obtain the equilibrium ticket sales and profits for the airline companies. The equilibrium solution is shown in Table 1.

The profit model and equilibrium in the case of two airline companies selling tickets through different franchisees

Airline companies do not need to assume marketing costs when they sell their tickets through franchisees (Figure 1b). The profit function for them can be expressed as follows:

$$\pi_j = w_{jj} q_{jj} \quad (j=1,2) \tag{6}$$

The marketing costs for the two airline companies' tickets are respectively borne by the two franchisees. The profit function for the franchisees is:

$$\pi_{Rj} = (p_{jj} - w_{jj}) q_{jj} - r_{jj} \quad (j=1,2) \tag{7}$$

Where:

$$q_{jj} = 1-(p_{jj} - \sqrt{r_{jj}}) + \theta\chi(p_{kk} - \sqrt{r_{kk}}) \quad (j=1,2; k=3-i) \tag{8}$$

The first step of calculating the equilibrium in DAS is to assume the wholesale price w_{jj} as a known parameter and derive the reaction functions of the franchisee's retail price p_{jj} and marketing costs $a_{jj} (= r_{ij}^{1/2})$ to wholesale price w_{jj} (Appendix A). The derived reaction functions can then be brought into the demand function (Equation 8) and then the profit function (Equation 6) to obtain the airline's profit that captures the reaction functions of retail price and marketing costs. Our objective is to help airline companies set the wholesale price for tickets that ensure maximum profit. Hence, we take the first order derivative of the wholesale price w_{jj} in the airline's profit function π_j to get the first order conditions for maximum profit of airline companies. By solving simultaneous equations, we can obtain the equilibrium wholesale price. Finally, we bring this wholesale price into the reaction functions to get the

Table 1. The equilibrium solutions in the integrated structure and the decentralized franchisee structure.

Variable	Channel structure/power		
	I	DAS	DFS
w	–	$\frac{-(3+\theta\chi)}{2(\theta^2\chi^2+\theta\chi-3)}$	$\frac{B}{(2-\theta\chi)C}$
p	$\frac{2}{3-\theta\chi}$	$\frac{3(\theta^2\chi^2-5)}{A}$	$\frac{D}{(2-\theta\chi)C}$
q	$\frac{2}{3-\theta\chi}$	$\frac{2(\theta^2\chi^2-3)}{A}$	$\frac{E}{(2-\theta\chi)C}$
r	$(\frac{1}{3-\theta\chi})^2$	$(\frac{\theta^2\chi^2-3}{A})^2$	$(\frac{F}{C})^2$
π	$\frac{3}{(3-\theta\chi)^2}$	$\frac{-(3+\theta\chi)(\theta^2\chi^2-3)}{(\theta^2\chi^2+\theta\chi-3)A}$	$\frac{BE}{(2-\theta\chi)^2C^2}$
π_R	–	$\frac{3(\theta^4\chi^4-6\theta^2\chi^2+9)}{A^2}$	$\frac{E(D-B)-(2-\theta\chi)^2F^2}{(2-\theta\chi)^2C^2}$

$A=-2\theta^3\chi^3+4\theta^2\chi^2+12\theta\chi-18$: $B=2\theta^6\chi^6+2\theta^5\chi^5-17\theta^4\chi^4-11\theta^3\chi^3+56\theta^2\chi^2+6\theta\chi-44$,
$C=-3\theta^4\chi^4-\theta^3\chi^3+20\theta^2\chi^2+6\theta\chi-28$: $D=2\theta^6\chi^6+2\theta^5\chi^5-19\theta^4\chi^4-11\theta^3\chi^3+64\theta^2\chi^2+140\theta\chi-76$,
$E=2\theta^6\chi^6-16\theta^5\chi^5-17\theta^4\chi^4-11\theta^3\chi^3-6\theta^2\chi^2+14\theta\chi-44$: $F=-2\theta^5\chi^5-4\theta^4\chi^4+12\theta^3\chi^3+24\theta^2\chi^2-16\theta\chi-32$

equilibrium retail price and marketing costs. Further, we can obtain the sales volume of each company's tickets and profits for each franchisee and airline company in equilibrium. The equilibrium solution is shown in Table 1. The first step of calculating the equilibrium in DFS is to assume the retail margin for franchisees is a known parameter and derive the two airlines' wholesale price reaction function w_{jj} (Appendix B).

In the next step, we can bring the reaction function into the franchisee's profit function (Equation 7) to get each franchisee's profits. By taking the first order derivative of retail margin m_{jj} and marketing cost $a_{jj}(=r_{jj}^{1/2})$, we can obtain the first order conditions for maximum profit of the franchisee. Solving the simultaneous equations will result in the retail margin in equilibrium. At last, we bring the retail margin into the reaction function to get the wholesale price in equilibrium, which can be used to derive the retail price (wholesale price + retail margin), ticket sales volume, franchisee's profit and airline company's profit. The equilibrium solution is as shown in Table 1.

The profit model and equilibrium in the case of two airline companies selling tickets through a common franchisee

In this case, the two airline companies sell tickets through one common franchisee (without loss of generality, this paper let the first franchisee be the common franchisee) (Figure 1c). The two companies also do not need to bear marketing costs. The profit function for them is given as:

$$\pi_j = w_{1j}q_{1j} \quad (j=1,2) \tag{9}$$

Only one franchisee sells the tickets for the two airline companies. Thus, this franchisee has to bear the ticket marketing costs of both companies. The franchisee's profit function is:

$$\pi_{R1}=(p_{11}-w_{11})q_{11}+(p_{12}-w_{12})q_{12}-r_{11}-r_{22} \tag{10}$$

where,

$$q_{1j}=1-(p_{1j}-\sqrt{r_{1j}})+\theta(1-\chi)(p_{1k}-\sqrt{r_{1k}}) \ (j=1,2;k=3-i) \tag{11}$$

Following Equations 10 and 11, we can get the equilibrium solution in CAS and CFS. The results are shown in Tables 2 and 3 respectively.

RESULTS ANALYSIS

Analysis of wholesale price and retail price

Figure 2 shows the relationship between the wholesale price and retail price in different settings of channel and power structures when there is no competition between franchisees (χ = 0). The following can be inferred from Figure 2:

(1) In any channel structure or level of competition between tickets, the wholesale price of tickets is always higher when the airline has the leadership.
(2) With the rising of competition between tickets (θ), the wholesale price and retail price of tickets will be higher when both airline companies sell tickets through one common franchisee than when they sell tickets through different franchisees. This is probably due to the fact that without competition from other franchisees, the franchisee selling tickets for both airline companies is

Table 2. The equilibrium solution in the common franchisee structure.

Variable	Channel structure/power
	CAS
w	$\frac{-\theta^3(1-\chi)^3+3\theta^2(1-\chi)^2+\theta(1-\chi)-3}{G}$
p	$\frac{H+2[3+2\theta(1-\chi)-\theta^2(1-\chi)^2]G}{G\{[3-\theta^2(1-\chi)^2]^2-[2\theta(1-\chi)]^2\}}$
q	$\frac{[\theta(1-\chi)-1]H+[1-\theta(1-\chi)]J+[-9\theta^3+4\theta^2(1-\chi)^2-4\theta(1-\chi)+9]G}{G\{[3-\theta^2(1-\chi)^2]^2-[2\theta(1-\chi)]^2\}}$
r	$\{\frac{J+[1-\theta(1-\chi)][3+2\theta(1-\chi)-\theta^2(1-\chi)^2]G}{G\{[3-\theta^2(1-\chi)^2]^2-[2\theta(1-\chi)]^2\}}\}^2$
π	$\frac{LH+MJ+NG}{G^2\{[3-\theta^2(1-\chi)^2]^2-[2\theta(1-\chi)]^2\}}$
π_R	$\frac{H[\theta(1-\chi)-1][H+K]+J[1-\theta(1-\chi)][H+K]+GHO+GKQ+[3-\theta(1-\chi)]GJ+RG^2}{G^2\{[3-\theta^2(1-\chi)^2]^2-[2\theta(1-\chi)]^2\}^2}$

$G=2[\theta^4(1-\chi)^4-2\theta^3(1-\chi)^3+2\theta^2(1-\chi)^2+2\theta(1-\chi)-3]$
$H=-\theta^7(1-\chi)^7+5\theta^6(1-\chi)^6-\theta^5(1-\chi)^5-19\theta^4(1-\chi)^4+5\theta^3(1-\chi)^3+23\theta^2(1-\chi)^2-3\theta(1-\chi)-9$
$J=-\theta^7(1-\chi)^7+7\theta^6(1-\chi)^6-13\theta^5(1-\chi)^5-5\theta^4(1-\chi)^4+29\theta^3(1-\chi)^3-11\theta^2(1-\chi)^2-15\theta(1-\chi)+9$
$K=\theta^7(1-\chi)^7-7\theta^6(1-\chi)^6-2\theta^5(1-\chi)^5-13\theta^4(1-\chi)^4+39\theta^3(1-\chi)^3+27\theta^2(1-\chi)^2+9\theta(1-\chi)-27$
$L=-\theta^4(1-\chi)^4+4\theta^3(1-\chi)^3-2\theta^2(1-\chi)^2-4\theta(1-\chi)+3;$ $M=\theta^4(1-\chi)^4-4\theta^3(1-\chi)^3+2\theta^2(1-\chi)^2+4\theta(1-\chi)-3$
$N=9\theta^6(1-\chi)^6-31\theta^5(1-\chi)^5+7\theta^4(1-\chi)^4+10\theta^3(1-\chi)^3+11\theta^2(1-\chi)^2+21\theta(1-\chi)-27$
$O=-11\theta^3(1-\chi)^3+10\theta^2(1-\chi)^2-2\theta(1-\chi)+3:$ $Q=-9\theta^3(1-\chi)^3+4\theta^2(1-\chi)^2-4\theta(1-\chi)+9$
$R=18\theta^5(1-\chi)^5-44\theta^4(1-\chi)^4-31\theta^3(1-\chi)^3-7\theta^2(1-\chi)^2+13\theta(1-\chi)+51$

able to sell the tickets at higher prices. This franchisee will be more willing to accept higher wholesale prices as well. This result is consistent with Choi's (1991) finding that retail price is higher in the common dealer structure than in the exclusive dealer structure.

(3) Tickets sold through franchisees have higher retail prices than those sold directly by airline companies. This explains why consumers purchase some tickets directly from airline companies because their retail prices are lower. This result echoes the findings of previous literature.

Figure 3 shows the relationship between the wholesale price and retail price in different settings of channel and power structures when there is intense competition between franchisees (χ = 0.95). Our findings from this figure are summarized as follows:

(1) In the channel structure where the two airlines sell tickets through different franchisees, both retail price and wholesale price will increase with the competition between tickets, no matter who has the leadership.

(2) In the structure where both airlines choose the same franchisee to sell tickets for them, the franchisee cannot enjoy the advantage of monopoly in a highly competitive environment. Thus, there will be less fluctuation in the wholesale price and retail price of the tickets.

(3) With the rising of competition between tickets (θ), airline companies can choose a different franchisee to sell their tickets to reduce the impact of competition on them. This finding is consistent with McGuire and Staelin's (1983) argument that retailers provide buffering to manufacturers from price competition when their products are highly substitutable.

Analysis of marketing cost and ticket sales

Figure 4 shows the relationship between marketing cost and ticket sales in different settings of channel and power structures when there is no competition between franchisees (χ = 0). Our findings from Figure 4 are as follows:

(1) The marketing cost for tickets is higher when the tickets are sold by airline companies themselves than when the tickets are sold by franchisees.

(2) In the channel structure where the two companies sell tickets through the same franchisee, as mentioned in the previous section, franchisees can retail the tickets at higher prices and thus will be willing to spend more on marketing the tickets. Their investment in marketing will increase with the rise of competition between tickets (θ).

(3) In the channel structure where the two airlines sell

Table 3. The equilibrium solution in the common franchisee structure.

Variable	Channel structure/power
	CFS
w	$\frac{T+[2+\theta(1-\chi)]S}{S\,[4-\theta^2(1-\chi)^2]}$
p	$\frac{[2+\theta(1-\chi)]\{-2[4-\theta^2(1-\chi)^2]+S\}+T}{S\,[4-\theta^2(1-\chi)^2]}$
q	$\frac{[\theta(1-\chi)-1][T+U]+[\theta(1-\chi)+2]S}{S\,[4-\theta^2(1-\chi)^2]}$
r	$[\frac{\theta^3(1-\chi)^3+3\theta^2(1-\chi)^2-4}{S}]^2$
π	$\frac{T[\theta(1-\chi)-1][T+U]+\left[\theta^2(1-\chi)^2+\theta(1-\chi)-2\right]SU+\theta(1-\chi)[\theta(1-\chi)+2]ST}{S^2[4-\theta^2(1-\chi)^2]^2}$
π_R	$\frac{4V[T+U]+2SZ}{S^2[4-\theta^2(1-\chi)^2]}$

$S=-3\theta^4(1-\chi)^4-2\theta^3(1-\chi)^3+21\theta^2(1-\chi)^2+12\theta(1-\chi)-28$
$T=\theta^5(1-\chi)^5+2\theta^4(1-\chi)^4-9\theta^3(1-\chi)^3-22\theta^2(1-\chi)^2+4\theta(1-\chi)+24$
$U=-\theta^5(1-\chi)^5-\theta^4(1-\chi)^4+12\theta^3(1-\chi)^3+16\theta^2(1-\chi)^2-32\theta(1-\chi)-48$
$V=\theta^4(1-\chi)^4+\theta^3(1-\chi)^3-6\theta^2(1-\chi)^2-4\theta(1-\chi)+8$
$Z=\theta^5(1-\chi)^5+5\theta^4(1-\chi)^4+4\theta^3(1-\chi)^3-16\theta^2(1-\chi)^2-32\theta(1-\chi)-16$

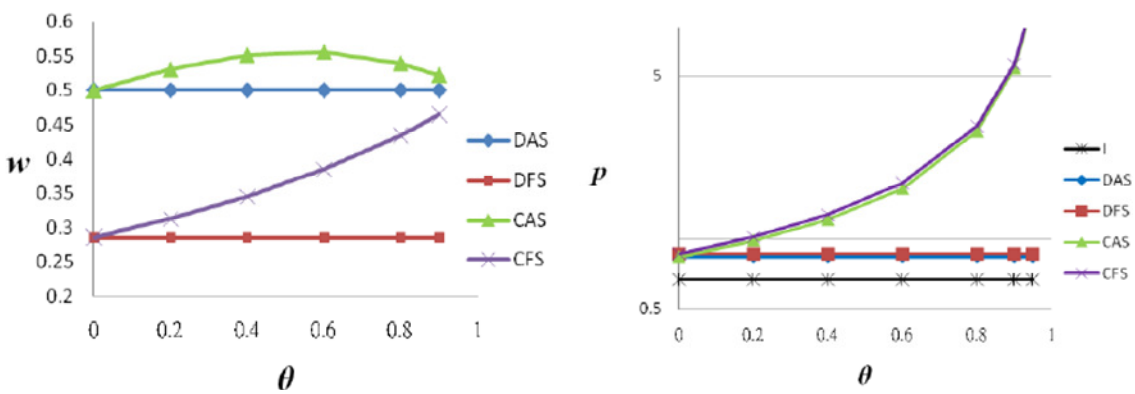


Figure 2. Analysis of wholesale price and retail price (χ = 0).

tickets through different franchisees, no franchisee has the advantage of monopoly. Thus, both franchisees have to retail the tickets at lower prices. Their willingness to invest more in marketing will also be lower.

(4) An increase in the marketing costs can lead to a risein the ticket sales. This does not support previous research's finding from the retail industry.

When the competition between franchisees is high (χ = 0.95) (Figure 5), the results of choosing the same or different franchisees are just opposite to the results in (2) and (3).

Analysis of airline's profits and franchisee's profit

Figure 6 presents the airline's profits in different settings of channel and power structures. It can be inferred from Figure 6:

(1) When there is no competition between franchisees (χ = 0), no matter the level of competition between tickets, airline companies can make more profits by selling tickets through their own channels than by adopting the two other channel structures. However, with the rise of competition between tickets, the profits for airline

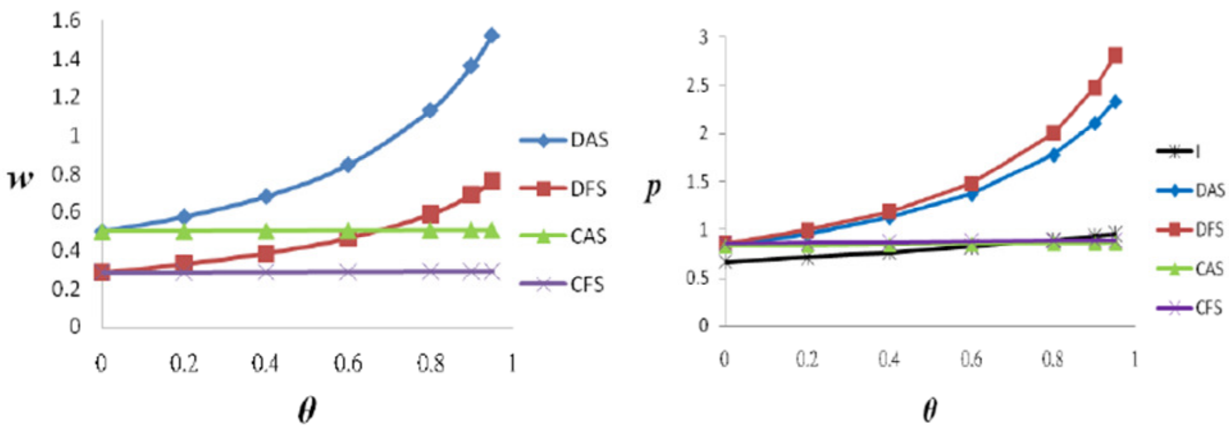


Figure 3. Analysis of wholesale price and retail price (χ = 0.95).

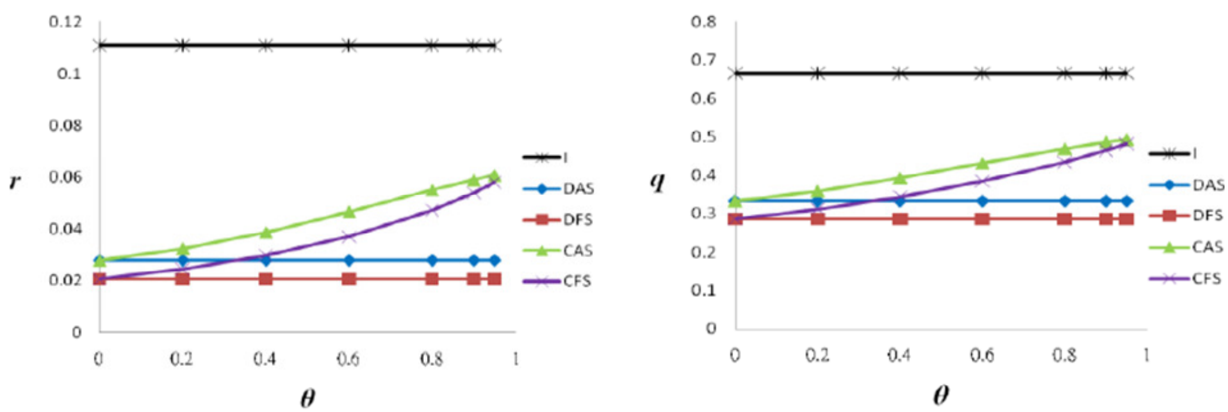


Figure 4. Analysis of marketing cost and ticket sales (χ=0).

companies selling tickets through one common franchisee will significantly increase.

(2) If competition between franchisees is high (χ=0.95) and ticket substitutability is low, airlines can make more profits by adopting the integrated channel than by adopting the other two channel structures. With the increase of ticket substitutability (θ), the channel structure in which the two airlines sell tickets through different franchisees and dominate the channel can yield more profits for airlines.

Figure 7 presents the franchisee's profits in different settings of channel and power structures. It can be inferred from Figure 7:

(1) When there is no competition between franchisees (χ = 0), no matter who has the leadership, the channel structure where the two airlines sell tickets through one common franchisee is most advantageous to the franchisee.

(2) If the competition between franchisees is high (χ=0.95) and the two airlines choose different franchisees to sell tickets for them, the franchisees' profit will increase with the increase in the competition between tickets (θ), particularly when the channel is dominated by the franchisees.

DISCUSSION

In this paper, we extended the demand function proposed by Trivedi (1998) by using marketing cost as a variable of demand. We first built the profit model for each channel structure and used it to obtain the equilibrium solution in each structure. Later, we analyzed and compared the airline's profits between different channel structures to find the optimum channel strategy for airline companies. Based on our analysis results, we proposed the optimum channel strategies for airline companies in four situations.

Situation 1: No competition between franchisees and tickets

For various reasons (such as capital of the airline company, agreement between nations, and airport

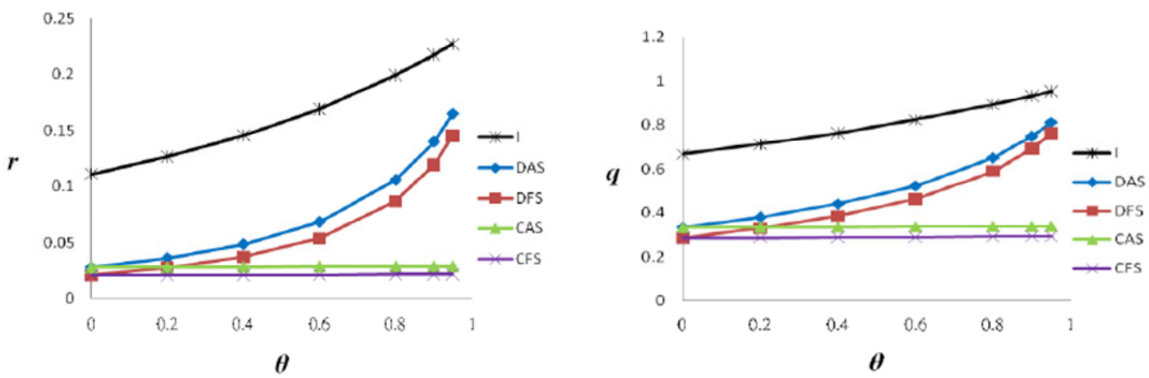
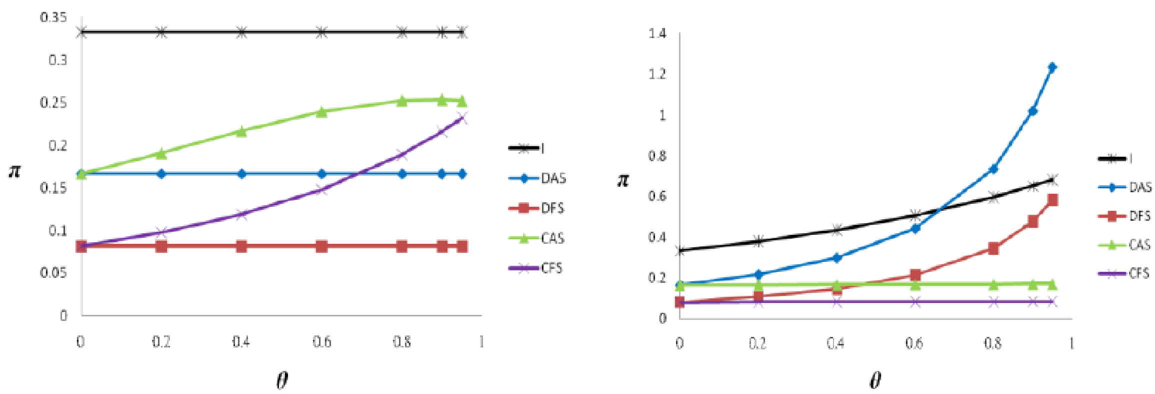


Figure 5. Analysis of marketing cost and ticket sales (χ=0.95).



(a) $\chi = 0$ (b) $\chi = 0.95$

Figure 6. Analysis of airline's profit.

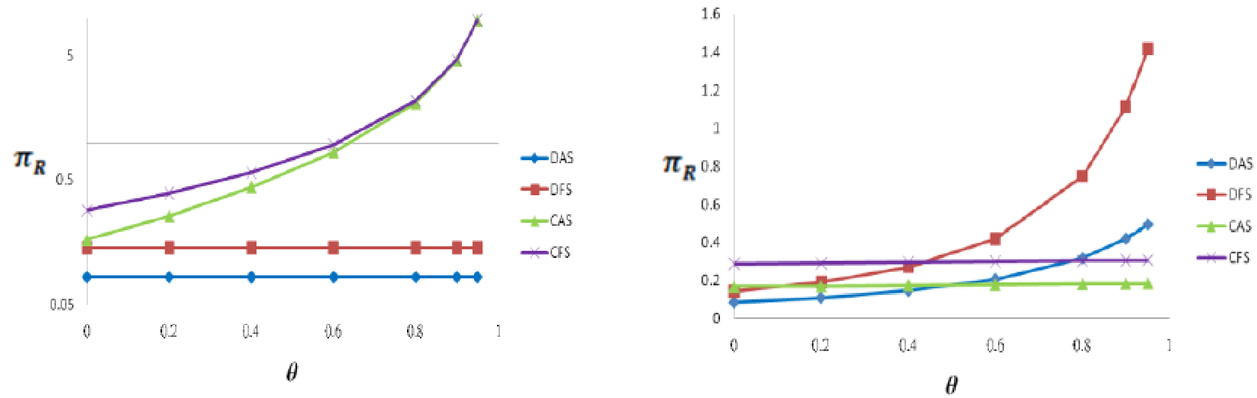
location), some routes are dominated by a few specific airlines, and there are many flights for these routes. Only a small number of franchisees plan trips for customers to destinations on these routes, and their services are highly differentiated. In this situation, the integrated channel strategy is the optimum choice for airline companies, whether in high or low seasons. Without any franchisee sharing the loss of vacant seats, airlines have to assume higher marketing costs than franchisees in order to increase the sales volume of the tickets to these routes. This explains why some airline companies offer itinerary planning service to customers and even set up travel agencies to boost their ticket sales. These airline companies not only arrange tour for customers but also use diversified promotional plans to attract non-tour passengers.

Situation 2: No competition between franchisees but high competition between tickets

This situation happens to regions on the routes frequently flown by a large number of airlines. These airlines have specific franchisees provide planning services for tours to these regions, and the franchisees' tour plans, services, and marketing plans are very professional and differentiated. In this situation, the integrated channel strategy is the optimum choice for airlines, whether in high or low seasons. Besides, if the two airlines sell tickets through the same franchisee, this franchisee can take the advantage of monopoly to retail the tickets at higher prices. Certainly, they can accept higher wholesale prices of the tickets set by the airlines. Thus, selling tickets through the franchisee that retails tickets for two airlines is indeed one of the best channel strategies for airlines.

Situation 3: High competition between franchisees but low competition between tickets

This situation usually happens in high reasons when the demand for tickets to some regions is larger than the supply. These regions refer to those on the routes flown



(a) $\chi = 0$ (b) $\chi = 0.95$

Figure 7. Analysis of franchisee's profit.

by most airline companies, and franchisees selling tickets to these regions offer similar tour plans. Because the season is favorable to the aviation industry, the integrated channel strategy is the optimum choice for airline companies in this situation. If the two airline companies sell tickets through different franchisees, they can adjust the wholesale price of their tickets to a higher level and can still enjoy a large sales volume. Thus, the channel with two airline companies selling tickets through different franchisee is one of the optimum choices for airline companies.

Situation 4: High competition between franchisees and between tickets

This situation happens to regions on routes frequently flown by most airlines, and most of whose franchisees also offer similar tour plans to these regions. In low seasons, both the integrated channel structure and the structure where the two airline companies sell tickets through different franchisees are optimum choices for airlines; in high seasons, only the latter structure is the optimum choice for airlines.

In this paper, we only compared airline's profits between three channel structures. Future researchers can extend our research in the following directions:

1. Include other channel structures: Future researchers can investigate airline's profits in other channel structures, such as the mixed channel structure mentioned in McGuire and Staelin (1983) or the full channel structure considered in Trivedi (1988), or in other different franchise patterns.
2. Increase the number of competitors and channel members in the model: Most previous research applying the game theory to channel choice assumed a duopoly market. Although increasing the number of competitors and channel members will increase the complexity of the model as well, the obtained results can be closer to realistic situations.
3. Consider consumer benefits: The demand function used in this paper was developed based on the demand function proposed by Trivedi (1998). Trivedi's (1998) demand function was extended from the demand function proposed by McGuire and Staelin (1983). The two preceding demand functions were developed according to the relationship between upstream and downstream firms, without considering consumer benefits. It is likely that a channel structure suggested by these demand functions can maximize the profits for airlines but is not accepted by consumers because the retail price is too high. Therefore, future researchers are suggested to take into account consumer benefits to develop a demand function that conforms to practical conditions.
4. Use a nonlinear demand function: As mentioned above, McGuire and Staelin (1983), Trivedi (1998) and this study all assumed that the demand function is a linear function. Under this assumption, the demand function might yield some illogical and unexplainable results. Future researchers are suggested to model airline's profits using a nonlinear demand function. Although the solution and analysis procedure will be more complicated, illogical results can be avoided. For instance, Choi (1991) used a nonlinear demand function to avoid the result that retailers can get more profits than manufacturers with the increase in product substitutability, which is against our intuitions.
5. Consider the virtual channel structure: Utility of virtual channels has significantly increased in recent years. This phenomenon can also be seen in the aviation industry. The prevalent use of computerized reservation systems (CRS) (for example, Abacus (1B) is the largest CRS in Asian regions) and airline companies' online service websites among passengers means the rise of electronic airline ticketing. Besides, using e-tickets is a global trend

in nowadays. We can say that airline ticketing channels have also entered an e-commerce era. However, for airline companies, the cost of selling tickets through virtual channels and the cost of selling tickets through franchisees are different, and the choice of virtual channels is completely different from the choice of franchise channels. Moreover, virtual channel is also a popular issue among recent channel selection studies. Therefore, future researchers can include virtual channels in the analysis to increase the diversity of channel choice for airline companies.

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APPENDIX A

To simplify the calculation, we let $a_j = r_{ij}^{1/2}$ as a known parameter and derive the reaction functions of the franchisee's retail price p_{jj} to wholesale price w_{jj} and marketing cost r_{jj} can be derived through the following steps: First, bring the demand function into the franchisee's profit function and then take the first order derivative of retail price p_{jj} and marketing cost $a_{jj}(=r_{jj}^{1/2})$ in the franchise's profit function:

$$\frac{\partial \pi_{R1}}{\partial p_{11}} = 1 - 2p_{11} + a_{11} + \theta\chi p_{22} - \theta\chi a_{22} + w_{11} = 0$$

$$\frac{\partial \pi_{R2}}{\partial p_{22}} = 1 - 2p_{22} + a_{22} + \theta\chi p_{11} - \theta\chi a_{11} + w_{22} = 0$$

$$\frac{\partial \pi_{R1}}{\partial a_{11}} = p_{11} - w_{11} - 2a_{11} = 0$$

$$\frac{\partial \pi_{R2}}{\partial a_{22}} = p_{22} - w_{22} - 2a_{22} = 0$$

Solving the simultaneous equations can yield the reaction functions of the franchisee's retail price:

$$p_{11} = \frac{(3+\theta^2\chi^2)w_{11} + 4\theta\chi w_{22}}{(3+\theta\chi)(3-\theta\chi)} + \frac{2}{3-\theta\chi}$$

$$p_{22} = \frac{4\theta\chi w_{11} + (3+\theta^2\chi^2)w_{22}}{(3+\theta\chi)(3-\theta\chi)} + \frac{2}{3-\theta\chi}$$

$$a_{11} = \frac{(\theta^2\chi^2-3)w_{11} + 2\theta\chi w_{22}}{(3+\theta\chi)(3-\theta\chi)} + \frac{1}{3-\theta\chi}$$

$$a_{22} = \frac{2\theta\chi w_{11} + (\theta^2\chi^2-3)w_{22}}{(3+\theta\chi)(3-\theta\chi)} + \frac{1}{3-\theta\chi}$$

APPENDIX B

The reaction function of wholesale price can be derived as follows: Let *m* denote the retail margin for franchisees, the retail prices of the two airline companies' tickets can be respectively represented by:

$$p_{11} = m_{11} + w_{11}$$

$$p_{22} = m_{22} + w_{22}$$

The demand function can be rewritten as:

$$q_{11} = 1 - (m_{11} + w_{11} - a_{11}) + \theta\chi(m_{22} + w_{22} - a_{22})$$

$$q_{22} = 1 - (m_{22} + w_{22} - a_{22}) + \theta\chi(m_{11} + w_{11} - a_{11})$$

Later, bring the modified demand function into the airline's profit function and take the first order derivative of the wholesale price w_{jj} to obtain the first order conditions for maximum profit of the airline:

$$\frac{\partial \pi_1}{\partial w_{11}} = 1 - m_{11} - 2w_{11} + a_{11} + \theta\chi m_{22} + \theta\chi w_{22} - \theta\chi a_{22} = 0$$

$$\frac{\partial \pi_2}{\partial w_{22}} = 1 - m_{22} - 2w_{22} + a_{22} + \theta\chi m_{11} + \theta\chi w_{11} - \theta\chi a_{11} = 0$$

By solving the simultaneous equations, we can obtain the reaction functions of wholesale price w_{jj} as follows:

$$w_{11} = \frac{(\theta^2\chi^2-2)m_{11} + \theta\chi m_{22} + (2-\theta^2\chi^2)a_{11} - \theta\chi a_{22}}{(2+\theta\chi)(2-\theta\chi)} + \frac{1}{2-\theta\chi}$$

$$w_{22} = \frac{\theta\chi m_{11} + (\theta^2\chi^2-2)m_{22} - \theta\chi a_{11} + (2-\theta^2\chi^2)a_{22}}{(2+\theta\chi)(2-\theta\chi)} + \frac{1}{2-\theta\chi}$$