ANALYZING FULL SERVICE AIRLINE – LOW COST CARRIER COMPETITION IN LIBERALIZED DOMESTIC AIR TRAVEL MARKETS

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Abstract

Air transport industry has been going through a worldwide transformation in the last decade. Aviation liberalization, started first in US in 1978, followed by EU through 1990s, has also caught on in many developing countries. Flag-carrier airlines previously enjoying monopoly rights in these countries have now faced stiff competition from lean start-up airlines with a simple product. These so called Low Cost Carriers, LCCs, have been instrumental in radically changing air travel in liberalized domestic markets. We build a simple model to analyze the effects of LCC entry to a previously monopolistic domestic air travel market. The airlines compete on both costs and service quality. Even though the model is quite basic, its predictions are consistent with the experience: a substantial fall in airline fares, a dramatic growth in the share of flying public and an increase in LCC market share.

1- Introduction

Air travel used to be a privilege of the few in rich countries before the Second World War. Today it is a service affordable by most in the west, and by the flourishing middle classes in many developing countries. Mainly two separate developments, one technological the other economic, were behind the phenomenal growth of air transportation worldwide.

First, advances in engine and airframe technologies led to introduction of larger and faster aircraft with dramatically lower unit costs in 1960s and early 1970s. The increase in aircraft productivity coupled with rising personal incomes fuelled air travel demand growth in the west until 1980s (Doganis, 2002).

Second, air transport industry, which had been traditionally heavily regulated, was beginning to be liberalized, starting in 1978 first in US, followed by EU in 1990s, and then rest of the world during the last decade. Although liberalization has still a long way to go in international aviation, its full-scale effects have been observed in domestic markets: competition has been intense as a result of new entry, dramatic capacity increases, falling yields and frequent price wars. Once again lower fares have stimulated air travel demand growth, but this time developing countries such as India, Brazil and Turkey have been part of this trend as well, registering very high growth rates in the last decade. In these countries, demand for airline seats surged and many first-time fliers took to the skies. For example, Turkish domestic air traffic increased more than 200% in the five years following 2003, when liberalization was completed and Turkish Airlines' monopoly ended (Airline Business, 2008).

A new airline business model gained force in this new competitive environment. The so called low cost carriers achieved $40-60\%$ lower unit costs by relentless cost control and a stripped-down product offer compared to the traditional Full Service Airlines, FSAs,. They were frequently able to sell seats for half the average FSA economy class fare (Doganis, 2006). LCCs have been the main factor behind air traffic growth especially since 2000.[2] The main characteristics of the basic LCC model and their impact on lowering the airline cost structure are as follows[3]:

- Point to point flights at secondary airports: avoiding investment in transfer passenger traffic and saving on airport charges,
- Single type fleet: savings on aircraft maintenance and flight crew training costs,
- Single class cabin with lower seat pitch: increase in number of aircraft seats, typically by 15% or more,

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[2] As of August 2009, 126 LCCs exist in the world. 54% of them were launched in the last five years, and about three fourths in the last decade. Although the low-cost model in its basic form goes back to early 1970s when Southwest began operations in US, LCCs have only recently become major players in short-haul markets (Centre for Asia Pacific Aviation, 2009).

[3] Although there are variations in application, many LCCs follow the given outline (Alamdari and Fagan, 2005). These characteristics are also the major differences with the typical FSA model.

- Baggage restrictions, unassigned seating and minimal in-flight services: reductions in turnaround time and increase in ancillary revenues,
- Using direct sales with heavy emphasis on internet: savings in sales & distribution costs,
- Minimal ground services and outsourcing most non-flight operations: savings on airport fees and administrative costs.

The LCC success has resulted in rapid market share gains: the LCC worldwide seat capacity increased from 7.8% in 2001 to 21.7% in 2009 against a stagnant FSA capacity (Centre for Asia Pacific Aviation, 2009). The growth of the LCC traffic in developing countries has been more dramatic as LCCs built up their market share from nothing in 2001 up to 50% in 2009 as Table 1 shows. LCCs are expected to increase their share in domestic markets over the near future (Mason and Alamdari, 2007).

Table 1. LCC share of domestic air travel market

Country	Market share (%)	Country	Market share (%)	Country	Market share (%)
India	54	UK	35	South Korea	22
Malaysia	53	Turkey	34	New Zealand	14
Brazil	50	Italy	33	France	8
Australia	48	Canada	32	Indonesia	6
Philippines	46	Thailand	29	Japan	5
Germany	44	USA	28	Russia	4
Mexico	42	Spain	26	Saudi Arabia	2
South Africa	38	Vietnam	23		

Source: Turkish Airlines (2009) for Turkey, Centre for Asia Pacific Aviation (2009) for the other countries.

FSAs have fought the LCC threat with two defensive measures. Most FSAs responded by lowering their fares to narrow the wide pricing gap. Some set up less-frills, lower cost subsidiaries to fight LCCs head on (Morrell, 2005). The first response has been somewhat successful, only when an FSA lowered its cost base significantly, but this frequently resulted in a trimmed-down product closer to the LCC offer. Subsidiaries usually failed because of the difficulty of achieving a competitive cost structure when the new airline shared resources and the culture with the parent airline (Graham and Vowles, 2006; Windle and Dresner, 1999; Dennis, 2007).

Some has been written on the penetration of LCCs. (Alderighi et al, 2004) and (Lee, 2006) build models of the FSA-LCC competition based on vertically differentiated service and different cost structures. (Alderighi et al, 2004) analyzes the impact of LCC and FSA entry under different market structures and find that LCC entry forces an FSA to lower both its economy and business class fares while an FSA entry has a lesser impact. (Lee, 2006) investigates the consequences of cost structure choice by ex-ante identical airlines and shows that an LCC could be more profitable than an FSA when there is a group of price sensitive passengers.

In this paper, however, we build a simple model to analyze the effects of introducing competition by an LCC to a previously monopolistic domestic airline market. This competition is mostly about cost differences and, to a lesser extent, about the service quality. Even though the model is quite basic, its predictions are consistent with the observations: a substantial fall in airline fares, a dramatic growth in the share of air travel and an increase in LCC market share. The model also highlights the sensitivity of the outcomes to the differences in costs and products. Thus striking predictions like the disappearance of the FSA service on short-haul routes reported by Mason and Alamdari (2007) can be explained within the model.

We proceed as follows: Section 2 delineates the model and explains the monopoly case where there is a single FSA. Section 3 analyzes the duopoly case and the effects of the penetration of an LCC. Section 4 discusses some selected comparative statics. And finally section 5 concludes.

2- Model

Historically, domestic civil aviation in most countries developed under the monopoly of a state owned airline. Therefore, we begin with the case where there is a single FSA, typically the flag carrier of the country, having monopoly rights over the air travel within the country.

There are N potential passengers who want to travel between two cities at a particular date. The distance between the cities is long enough so that travelling by air saves considerable time. Air travel would be the favourite option among the alternatives if the price weren't an issue.[4] For simplicity, we assume that all the N people will travel; they will either fly or travel by ground transport. We also assume that even the basic air travel product is not inferior (i.e. having less attributes) to that of the ground transport. The passengers are indexed by i where $i \in \{1,2,3,...,N\}$.

Passengers value savings in travel time so they are willing to pay more for an airline ticket. We assume that the monetary value of time savings depends mainly on income, and increases with it. Shires and de Jong (2009) report that the purpose of the journey, the distance and the country under study are other determinants of the value of travel time savings. Our focus here on income as the sole factor can be acceptable since we study travel on a single route in a single country. Moreover, even the choices of travellers sharing a common journey purpose seem to differ on income.[5]

Passengers value also the quality of service, i.e. the attributes of the air travel package, and have to choose between two types of FSA service differing in quality. Business Class (BC) is the higher quality service with airport lounges, privileged check-in and other ground services, ticket flexibility, last minute seat accessibility, better in-flight service, comfortable seats and generous loyalty programs (Frequent Flier Programs). Economy Class (EC) has limited ticket flexibility, more restrictive FFP and less luxurious in-flight offer but shares other advantages offered by FSA such as higher frequency of flights, seamless travel over a wider network, and more convenient airports (Shaw, 2007). $j \in \{0,1,2\}$ denotes different service levels, with EC indexed by 1 and BC by 2. (LC, the low cost service offered by LCC in the duopoly case, is indexed by 0.)

w_i is the monetary value of flying economy class for passenger i or her willingness to pay for EC. It reflects passenger i's value of the travel time savings *and* her valuation of the quality of EC. The value of reaching to the destination is the same for each passenger, whether she chooses the air travel or the ground transport; thus, we normalize the value of the ground transport to zero. We further assume that w_i is uniformly distributed between 0 and 1. Obviously this assumption is unrealistic as w_i is closely related to income. Even though a more realistic distribution would bring the model's predictions closer to actual observations, especially for BC demand, it wouldn't change the basic results.

a is a measure of the incremental value experienced by passengers when they upgrade from EC to BC. As a passenger's income increases, she tends to place more value on the luxury offered by BC; therefore, aw_i represents the improvement or the additional value of BC over EC for passenger i.

The FSA can increase the supply of seats flexibly by offering as many flights as it wants. This assumption is not unrealistic, especially in the long run, when new airport capacity can be developed. The unit cost of each service c_j, depends on its quality; thus, BC has the higher unit cost.

Monopoly case

We make the ideas in the previous paragraphs operational with the following utility function for passenger i:

[4] Usually the alternatives, travelling by car, by bus or by train, are strong competitors for shorter distances (300 km or less for Europe) since air travel has a marginal advantage in terms of door-to door travel times in these cases.

[5] Evangelho et al. (2005) find that business travellers working for big companies usually behave like "high income" passengers and choose to fly in the business class, while self-employed and employees of small firms choose LCCs.

$$U_i = \left\langle \begin{array}{ll} (1+a)w_i - p_2 & \textit{if she flies with FSA in BC} \\ w_i - p_1 & \textit{if she flies with FSA in EC} \\ 0 & \textit{if she travels by ground transport} \end{array} \right\rangle$$

p_j is the fare charged for the airline service j where p_1 and p_2 are EC and BC fares, respectively. The passenger will:

i. fly in BC if $(1+a)w_i - p_2 \geq w_i - p_1$ *and* $w_i \geq p_1$

ii. fly in EC if $(1+a)w_i - p_2 < w_i - p_1$ *and* $w_i \geq p_1$ **(1)**

iii. choose the ground transport if $w_i < p_1$

The passenger will choose BC if her income is high enough, $[w_i \geq (p_2 - p_1)/a]$. Otherwise, she will travel in EC as long as her willingness to pay for EC is higher than or equal to EC fare. Passengers at lower income levels will use the ground transport option. Fig. 1 illustrates the passenger's decision.

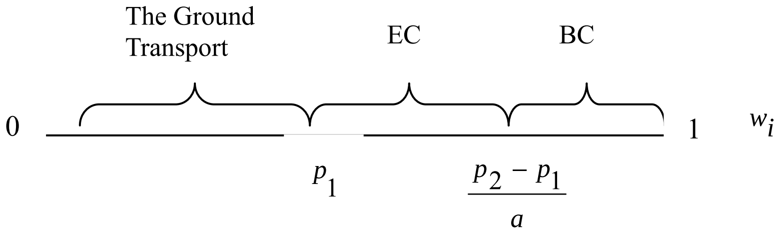

Fig. 1. Passenger i's travel decision on the $[0,1]$ w interval in the monopoly case

We can obtain the demand functions for BC and EC by using **(1)** and the assumption that w is uniformly distributed between 0 and 1**.** If passenger k is indifferent between buying a BC or EC ticket, $(1+a)w_k - p_2 = w_k - p_1$, then any passenger m having a slightly higher income, $w_m > w_k$, will prefer BC since the incremental utility from upgrading to BC, $(1+a)$, is greater than the utility gain of flying in EC, 1. On the other hand, if w_m is slightly less than w_k, passenger m will buy an EC ticket as $-(1+a)$ is less than -1. Therefore, the demand function for BC is

$$q_2 = N\left(1 - \frac{p_2 - p_1}{a}\right) = \frac{N}{a}(a - p_2 - p_1)$$

and the demand function for EC is

$$q_1 = N\left(\frac{p_2 - p_1}{a} - p_1\right) = \frac{N}{a}(p_2 - (1+a)p_1).$$

a must be in the interval $\left(p_2 - p_1, \frac{p_2 - p_1}{p_1}\right)$ for q_1 and q_2 to be defined and nonnegative. The profit function for the airline is $\pi_{FSA} = (N/a)[[p_2 - (1+a)p_1](p_1 - c_1) + (a - p_2 + p_1)(p_2 - c_2)]$.

Then the first order conditions and the resulting equilibrium values of prices and quantities will be:

$$\frac{\partial \pi_{FSA}}{\partial p_1} = \frac{N}{a}[2p_2 - 2(1+a)p_1 + (1+a)c_1 - c_2] = 0$$

$$\frac{\partial \pi_{FSA}}{\partial p_2} = \frac{N}{a}[2p_1 - 2p_2 - c_1 + c_2 + a] = 0$$

$$p_1^* = \frac{1 + c_1}{2}$$

$$p_2^* = \frac{1 + a + c_2}{2}$$

$$q_1^* = \frac{N}{2a}\left[c_2 - (1+a)c_1\right]$$
$$q_2^* = \frac{N}{2a}\left[a - c_2 + c_1\right]$$

The FSA behaves like a monopolist operating in two different markets: the airline chooses p_1 to equate the marginal revenue of EC, $1-2p_1$, to its marginal cost, c_1, as if it were offering only EC seats. The FSA determines p_2 similarly by equating the marginal revenue of BC, $1+a-2p_2$, to its marginal cost, c_2. The share of the passengers using air travel depends on the EC fare, and thus, on the unit cost of EC, c_1. Less than half of the potential passengers will travel by air as $p_1^* > 1/2$, and the more inefficient the FSA is the less the share of air travel will be. Even though either fare is independent of the unit cost of the other class, a change in either unit cost has an impact on both quantities. An increase in c_1 lowers the demand for EC by lowering p_1, but increases the demand for BC as $p_2 - p_1$ shrinks. A rise in c_2 creates the opposite effect. As a increases, BC becomes more attractive in the eyes of the passengers, so the demand for BC increases at the expense of EC demand.

3- LCC Entry and Duopoly

We aim to analyze the competition between the two business models; therefore we model the liberalized domestic airline industry as a duopoly of an FSA and an LCC. As the market is liberalized and competition is introduced with the LCC entry, the passengers now can choose among three airline products, BC and EC offered by the FSA and LC offered by the LCC. LC, the low cost travel, is the basic, no-frills package including only time savings and safety of air transportation. It is inferior to EC in the sense that it has less attributes. It also costs less, so the LCC has the lowest unit cost (c_0) among the three airline products.

The utility function for passenger i is modified as in the following:

$$U_i = \left\langle \begin{array}{ll} (1+a)w_i - p_2 & \text{if she flies with FSA in BC} \\ w_i - p_1 & \text{if she flies with FSA in EC} \\ (1-b)w_i - p_0 & \text{if she flies with LCC in LC} \\ 0 & \text{if she travels by ground transport} \end{array} \right\rangle$$

bw_i is passenger i's utility loss of downgrading from EC to LC, i.e. the inconvenience of giving up the EC attributes. b reflects the value of the service difference between EC and LC.[6] More well-off a passenger is, more likely she will be unsatisfied with the cramped seating position and the minimalist service in LC. Both a and b are constant: $a, b > 0$ and $0 < b < 1$. One would expect both a and b to be increasing functions of income such that they will be increasing moderately throughout the low to middle income range, and then rise rapidly at higher incomes. Using multiple values of a and b would improve the predictions, but wouldn't improve the basic results.

The i^{th} passenger's decision process now includes the LCC option:

i. fly in BC if $(1+a)w_i - p_2 \geq w_i - p_1$ *and* $w_i \geq p_1$

ii. fly in EC if $(1+a)w_i - p_2 < w_i - p_1$ *and* $w_i - p_1 \geq (1-b)w_i - p_0$ *and* $w_i \geq p_1$

iii. fly in LC if $w_i - p_1 < (1-b)w_i - p_0$ *and* $w_i \geq \frac{p_0}{1-b}$

[6] O'Connell and Williams (2006) report for Indian passengers that they choose an FSA for its service quality, flight schedule, connections and reliability whereas low fare is almost the single reason for the LCC choice. LC-EC service level difference is more starkly observed when the LCC fare includes only travel aboard an aircraft, and all other services typically included in EC fare such as booking over phone, seat selection, checked baggage, in-flight food and beverages, entertainment are seen as ancillary revenue sources by the LCC. Some US legacy airlines have begun practicing ancillary charges similar to LCCs but there is a growing frustration over the practice among passengers.

iv. choose the ground transport if $w_i < \dfrac{p_0}{1-b}$

Alternatively, her decision can be shown as in Fig. 2:

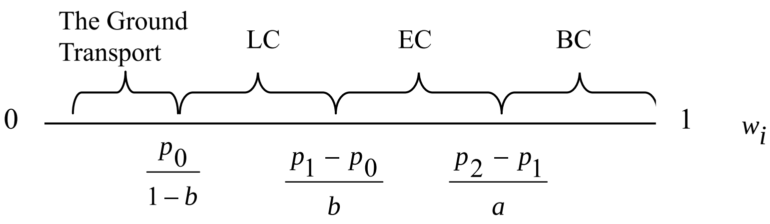

Fig. 2. Passenger i's travel decision on the $[0,1]$ w interval in the duopoly case

We continue assuming that the airlines can increase the supply of seats at will. The demand functions are obtained similarly as in the monopoly case:

$$q_2 = \frac{N}{a}(a - p_2 + p_1)$$

$$q_1 = \frac{N}{ab}\left[ap_0 + bp_2 - (a+b)p_1\right]$$

$$q_0 = \frac{N}{b(1-b)}\left[(1-b)p_1 - p_0\right]$$

The profit functions for the two airlines can be written as:

$$\pi_{FSA} = \frac{N}{a}\left[(a - p_2 + p_1)(p_2 - c_2) + \frac{\left[ap_0 + bp_2 - (a+b)p_1\right](p_1 - c_1)}{b}\right]$$

$$\pi_{LCC} = \frac{N}{b(1-b)}\left[(1-b)p_1 - p_0\right](p_0 - c_0)$$

Both airlines know the true values of $c_j, a, b,$ and N. The LCC sets p_0 and the FSA sets p_1 and p_2 so as to maximize their respective profit function. Although a dynamic game with incomplete information might be more appropriate to analyze strategic interaction between the airlines, the simple model here can be seen as a satisfactory compromise as long as we are interested in predicting the market shares in a long-run equilibrium.

The first order conditions are

$$\frac{\partial \pi_{FSA}}{\partial p_1} = \frac{N}{a}\left[(p_2 - c_2) + \frac{ap_0 + bp_2 - (a+b)p_1}{b} - \frac{(a+b)(p_1 - c_1)}{b}\right] = 0$$

$$\frac{\partial \pi_{FSA}}{\partial p_2} = \frac{N}{a}\left[(a - p_2 + p_1) - (p_2 - c_2) + (p_1 - c_1)\right] = 0 \qquad \textbf{(2)}$$

$$\frac{\partial \pi_{LCC}}{\partial p_0} = \frac{N}{b(1-b)}\left[((1-b)p_1 - p_0) - (p_0 - c_0)\right] = 0$$

We get the equilibrium prices from (2),

$$p_1^* = \frac{c_0 + 2(c_1 + b)}{3+b}$$

$$p_2^* = \frac{2c_0 + (1-b)(c_1 + b) + (3+b)(a + b + c_2)}{2(3+b)}$$

$$p_0^* = \frac{2c_0 + (1-b)(c_1 + b)}{3+b}$$

and by plugging the equilibrium prices into the demand equations, we find the equilibrium quantities:

$$q_1^* = \frac{N}{2ab}\left[\frac{2ac_0 + b(3+b)(a+c_2-c_1) - 2a(1+b)(c_1+b)}{3+b}\right]$$

$$q_2^* = \frac{N}{2a}(a - c_2 + c_1)$$

$$q_0^* = \frac{N}{b(1-b)}\left[\frac{(1-b)(c_1+b) - (1+b)c_0}{3+b}\right]$$

Finally, the equilibrium levels of airline profits are given by

$$\pi_{FSA}^* = \frac{N}{4ab(3+b)^2}\begin{Bmatrix} 2[c_0 + 2b - (1+b)c_1][2ac_0 + b(3+b)(a+c_2-c_1) - 2a(1+b)(c_1+b)] + \\ [b(3+b)(a-c_2+c_1)][2c_0 + (1-b)(c_1+b) + (3+b)(a+b-c_2)] \end{Bmatrix}$$

$$\pi_{LCC}^* = \frac{N}{b(1-b)(3+b)^2}[(1-b)(c_1+b) - (1+b)c_0]^2$$

We will first provide an example that could be helpful in highlighting the model's working, and then, we will discuss the comparative statics results in Section 4.

A numerical example

We arbitrarily set the unit cost of EC, c_1, equal to 0.25 or one-fourth of the highest travel budget $(w=1)$, and the unit cost of BC, c_2, equal to double the unit cost of EC. We let the value of the BC service to be 30% better than the EC service ($a = 0.3$).[7] Under this scenario, the share of air travel would be 37.5% with $p_1 = 0.625$ and $p_2 = 0.90$ in the monopoly case. Business class passengers would constitute 22% of the FSA passengers. High fares would drive many passengers away from the airline. Even though c_1 and a are set arbitrarily, the main result does not change significantly when these variables are given different values. A 30% increase in c_1 decreases the share of air travel only by 4%. Variation in a leads to different allocations of the FSA passengers between EC and BC, but has no impact on the share of air travel.

To continue the example with the duopoly case, we let LC unit cost, c_0, to be 60% of EC unit cost ($c_0 = 0.15$) and the value of LC service to be 80% of EC service ($b = 0{,}2$).[8] In the duopoly equilibrium, the share of passengers travelling by air doubles to 74%, the market share of the FSA drops to 53%, the EC and BC fares fall by 47% and 33%, respectively, compared to the monopoly case. The LCC gains almost half of the air travel market (47%) by pricing its seats 37% lower than the FSA's EC fare. The FSA's profit is higher than the LCC's, partly because of attracting higher income passengers with the BC product. Nevertheless, it is only one fourth of the FSA profit in the monopoly case.

Figs 3 and 4 illustrate how the equilibrium values of prices and quantities change as the ratio of LC and EC unit costs changes. We still set $c_1 = 0.25$, $c_2 = 0.5$, $a = 0.3$, $b = 0.2$ as in the example, but now let c_0 change. The ratio of LC and EC unit costs (c_0/c_1) is on the horizontal axis.

All fares increase with the diminishing LCC cost advantage. An increase in the LC unit cost leading to a higher LC fare allows the FSA to increase its profit margin without the risk of losing passengers to the LCC. Fig. 4 shows that, in this case, the FSA gains market share by increasing the number of

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[7] Turkish Airlines is the typical FSA. With very rough calculations, we estimate for Turkish Airlines the cost of an economy class seat on an average 700 km sector to be around \$55 (80TL). When we set $c_1 = 0.25$, the average travel budget would be \$110 (160TL) in the model. Given the restrictive assumption of travel budget being unitarily distributed, this estimate could be excusable for a country where average monthly personal income is about \$800. We have no way of guessing a and b. They are the average values of all passenger valuations, so their estimates would be more forgiving.

[8] The unit cost of Pegasus Airlines, the major LCC in Turkey, is about 40% lower than that of Turkish Airlines (Air Transport World, 2009). We set the value for b arbitrarily. See Footnote 7. A change in b has a small effect on the share of air travel but as Fig. 5 shows, its effect on LCC market share is significant.

passengers in its economy class as the LCC share responds negatively to an increase in the cost ratio.

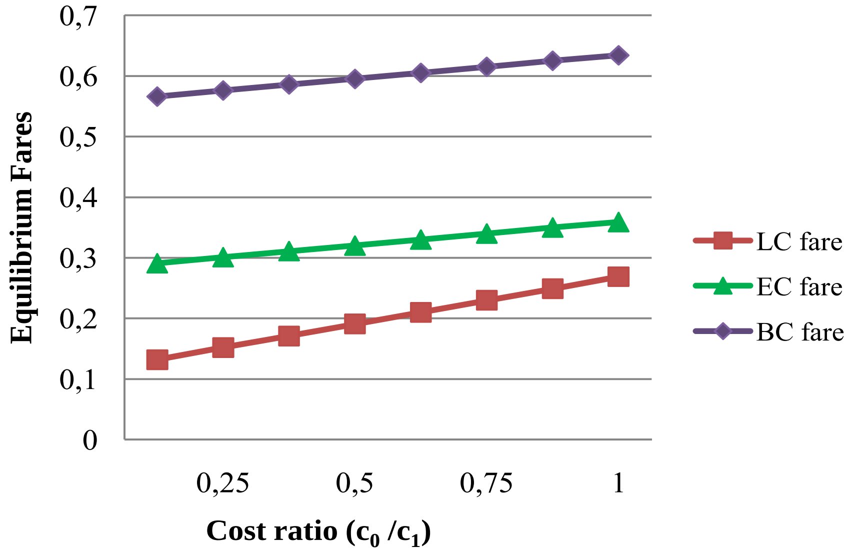

Fig. 3. Equilibrium fares under different LC – EC unit cost ratios

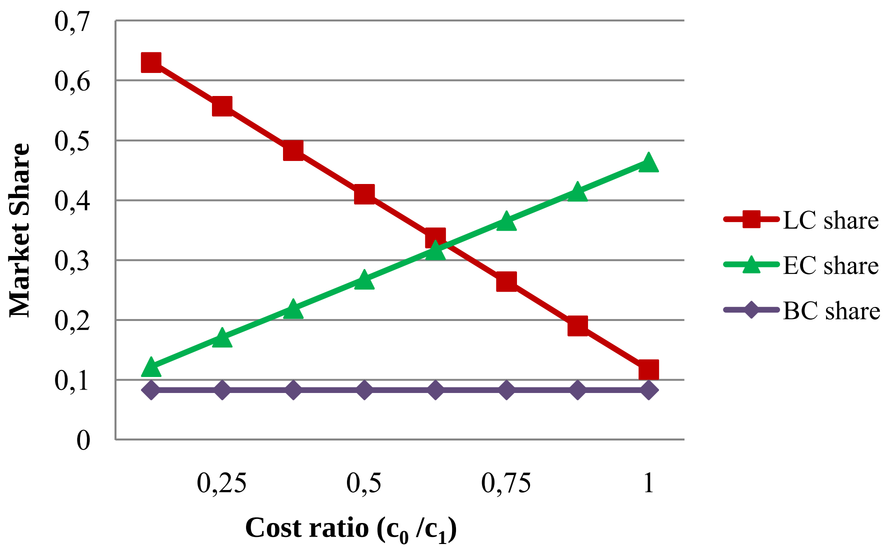

Fig. 4. Equilibrium passenger shares of airlines under different LC – EC unit cost ratios

4- Discussion

LCCs around the world try obsessively to reduce or at least control their costs. This has been the necessary and almost sufficient condition for their success. The results of the model underline this crucial role played by unit costs in determining the equilibrium outcomes. In the model, LC and EC are direct rivals for lower to middle income passengers.[9] The fare for either service depends on the LC and EC unit costs and the disutility of flying in LC, b. A decrease in the LC unit cost c_0 enables the LCC to gain market share by lowering its price. Some of the new LCC customers will be those who would otherwise travel by the ground transport, but the rest will come from the FSA's EC passengers. The FSA responds by lowering p_1 (also p_2, as a result of optimal price discrimination among its passengers), but drop in p_1 doesn't match the LCC's price cut. Consequently, the demand for EC falls and the LCC's profit increases at the expense of the FSA's. The same mechanism works in the FSA's

[9] This doesn't mean that LCC is not attractive for business travellers. Even a business traveller might be "low" or "high" income. See Footnote 5.

favour if c_1 drops relative to c_0.[10] When the FSA lowers p_1, it has to drop p_2 as well to prevent high yielding BC passengers switching to EC. The drop in p_2 is such that the number of BC passengers does not vary in response to a change in the LC unit cost, as can be seen in Fig. 4. In the model, an increase in the cost of a BC seat, c_2, has an impact on only p_2 and q_2; the BC fare increases, which leads to a fall in the number of BC passengers.

The other major variable shaping the competition between the LCC and the FSA, b, is a measure of substitutability between EC and LC. Fig. 5 shows the response of the LCC market share to different values of b and the cost ratio. We set $c_1 = 0.25$, $c_2 = 0.5$, $a = 0.3$ as before. The LCC share increases as the cost difference increases and/or the quality difference, b, decreases. When LC and EC become closer substitutes, or b falls, both airlines lower their fares. This results in a more robust LC demand and a higher LCC profit while the EC demand and the FSA profit fall. In fact, when passengers consider LC as a very close substitute for EC (when b is close to 0) and the LCC has significant cost advantage, EC service becomes loss making and the FSA model cannot be sustained in the equilibrium. In this case, the only option for the FSA, other than withdrawing from the market, is to be an all-business class carrier. This result is in line with some experts' prediction of the disappearance of FSAs on intra-EU routes in the future and with the moves of some FSAs in developing countries to set up low fare - low service subsidiaries and shift their domestic capacity to these airlines.[11]

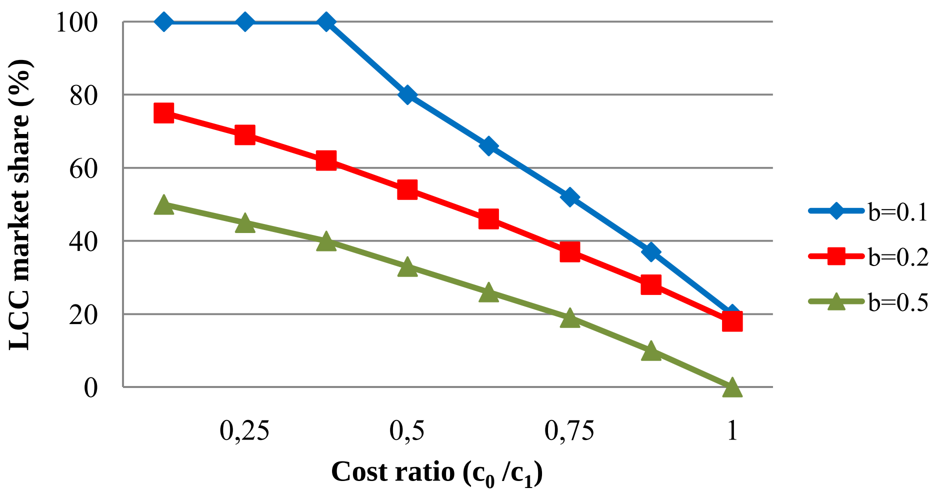

Fig. 5. LCC share of air travel as a function of *b* under different LC – EC unit cost ratios

The role b plays in the model is consistent with the observations in the air transportation industry. LCCs constantly experiment with raising their service level in order to close the quality gap (Alamdari and Fagan 2005). On the other hand, FSAs keep on trying to create and sustain a perception of superior quality in the minds of passengers. IATA (2006) believes that "efficient differentiation", maintaining a high-quality airline service at a lower cost structure, even though still higher than that of LCCs, might protect FSAs from the LCC threat.

The FSA has more pricing power for BC seats, which are preferred by the highest willingness-to-pay passengers. The BC product is more in competition with EC than it is with LC because it is more differentiated ($a > 1 > b$). An increase in a, by making the BC service more attractive, allows the FSA to raise the BC fare. Some passengers who otherwise would have flown in EC now prefers BC despite the higher fare. Therefore, the FSA makes a higher profit as a result of an increase in q_2, a

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[10] O'Connell and Williams (2006) find that closing the price gap between LC and EC would cause two thirds of LCC passengers switch to an FSA in India. Our model also predicts that LCC market share drops significantly when the cost ratio converges to 1 as shown in Fig. 4 and Fig. 5. There is always a price gap between EC and LC in our model, but this gap narrows as LCC's cost advantage diminishes.

[11] Jet Airlines in India has been channelling its domestic capacity to its LCC subsidiary. Turkish Airlines has recently started doing the same in Turkey.

decrease in q_1, and q_0 remaining unchanged.

Lastly, the share of passengers using air travel depends on the LC fare, which, in return, is determined by the values of c_0, c_1 and b in the model. A decrease in any of these variables leads to more passengers choosing air travel, c_0 having the most effect and b the least. On the other hand, the model does not explicitly include the effect of income growth, which has been historically an important driver of air travel demand (Holloway, 2008). The variable related to income, w, is normalized to $[0,1]$. Nevertheless, income growth can be introduced into the model as a proportionally equal fall in all unit costs. This would increase the air travel demand as fares would fall and the effect would be equivalent to an increase in income.

5- Conclusion

In this article, we study the competition between two different airline business models, an FSA and an LCC. Specifically, we analyze the effects of the entry by an LCC to a domestic air travel market previously monopolized by an FSA. We show that following the penetration of the LCC, the FSA fares for both EC and BC drop significantly in response to the low LC fare. This leads to a dramatic increase in the share of public using air travel. The LCC gains a substantial share of the growing market. We provide a numerical example with plausible parameter values that predicts doubling of air traffic and almost equal market shares for the two airlines in line with actual data.

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