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. Traditional 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: substantial fall in airline fares, dramatic growth in the share of flying public and increase in LCC market share.

Key Words: low cost carrier, full service airline, competition.
Jel Code: D430

I. 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. Two separate developments, one technological the other economic, were mainly 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 traditionally been 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

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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 has arisen in this new environment conducive to experimentation and been the main factor behind air traffic growth especially since 2000.[3] The so called low cost carriers achieved $40-60\%$ lower unit costs compared to the traditional Full Service Airlines, FSAs, by relentless cost control and a stripped-down product offer. They were frequently able to sell seats for half the average FSA economy class fare (Doganis, 2006). The main characteristics of the basic LCC model and their impact on lowering cost structure are as follows[4]:

- 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,
- 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.

LCC success has resulted in rapid market share gains: LCC worldwide seat capacity increased from 7.8% in 2001 to 21.7% in 2009 against stagnant FSA capacity (Centre for Asia Pacific Aviation, 2009). The growth of 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).

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[3] 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).

[4] 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.

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 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 LCC offer. Subsidiaries usually failed because sharing resources and culture with the parent airline prevented the subsidiary to achieve a competitive cost structure (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 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 LCC competition to a previously monopolistic domestic airline market. This competition is mostly about cost differences and, to a lesser degree, about service quality. Even though the model is quite basic, its predictions are consistent with the observations: substantial fall in airline fares, dramatic growth in the share of air travel and 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

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.

II. Model

Historically, domestic civil aviation developed under the monopoly of a state owned airline in most countries. Therefore we begin with the case where there is a single FSA, typically the flag carrier of the country, having monopoly rights over 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 air travel saves considerable time. Air travel would be the favourite option among alternatives if price weren't an issue.[5] 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 ground transport. The passengers are indexed by i where $i \in \{1,2,3,\ldots,N\}$.

Passengers value savings in travel time so they are willing to pay more for air travel. We assume that the monetary value of time savings depends mainly on income and increases with it. Even though journey purpose, distance and the country under study are other determinants of value of travel time savings (Shires and de Jong, 2009), this assumption can be acceptable here since we study domestic travel on a fixed route. Moreover, even air travel choices of business travellers, who share common journey purpose, seem to differ on income.[6]

Passengers value also the quality of service, i.e. attributes of 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

[5] 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 this case.

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

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 travel time savings *and* her valuation of EC quality. Value of reaching to the destination is the same for both air travel and ground transport, so we normalize the value of 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 measures how much passengers value the extras of BC over EC proportionally. As passengers' income increases, they tend to place more value on the luxury offered by BC, therefore aw_i represents the improvement or the additional value of upgrading from EC to BC for passenger i.

FSA can increase the supply of seats flexibly by offering as many flights as it deems necessary. 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 or richness, so 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:

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

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

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

ii. fly in EC if $(1+a)w_i - p_2 < w_i - p_1 \ \textit{and} \ w_i \geq p_1$ **(2)**

iii. choose ground transport if $w_i < p_1$

The passenger will choose BC if her income is high enough $\left[w_i \geq (p_2 - p_1)/a\right]$, 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 ground transport. Fig. 1 illustrates the passenger's decision.

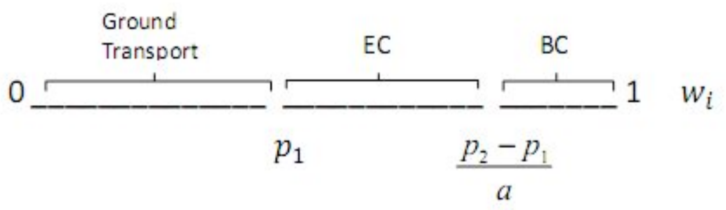

Fig. 1. Passenger i's travel decision on w continuum in the monopoly case

We can obtain the demand functions for BC and EC by using **(2)** 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 even a slightly higher income, $w_m > w_k$, will prefer BC since the incremental utility from upgrading, $(1+a)$, 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 since $-(1+a) < (-1)$. Therefore the demand functions for BC and EC are $q_2 = (N/a)[a - p_2 + p_1]$ and $q_1 = (N/a)[p_2 - (1+a)p_1]$, respectively.

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:

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

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

$$p_1^* = \frac{1+c_1}{2} \tag{3}$$

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

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

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

The share of passengers using air travel depends on EC fare, so on the unit cost of EC, c_1. Less than half of the potential passengers will travel by air as $p_1^* > 1/2$. The BC fare depends on the unit costs of EC and BC and the value added of BC, a. 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 passengers, so the demand for BC increases at the expense of EC demand.

III. 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 domestic aviation market is liberalized and competition is introduced with LCC entry, passengers now can choose among three airline products, BC and EC offered by FSA and LC offered by LCC. LC, 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 LCC has the lowest unit cost (c_0) among the three airline products.

The utility function for passenger i is modified as:

$$U_i = \left\langle \begin{array}{ll} (1+a)w_i - p_2 & \textit{if she flies with FSA in BC} \\ w_i - p_1 & \textit{if she flies with FSA in EC} \\ (1-b)w_i - p_0 & \textit{if she flies with LCC in LC} \\ 0 & \textit{if she travels by ground transport} \end{array} \right\rangle \quad \textbf{(4)}$$

bw_i is passenger i's utility loss of downgrading from EC to LC, i.e. the inconvenience of giving up EC attributes. b reflects the value of service difference between EC and LC proportionally.[7] 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 $(1+a)w_i - p_2 \geq w_i - p_1 \ \textit{and} \ w_i \geq p_1$

ii. fly in EC if $(1+a)w_i - p_2 < w_i - p_1 \ \textit{and} \ w_i - p_1 \geq (1-b)w_i - p_0 \ \textit{and} \ w_i \geq p_1$ **(5)**

[7] 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 LCC choice. LC-EC service level difference is more starkly observed when 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.

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

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

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

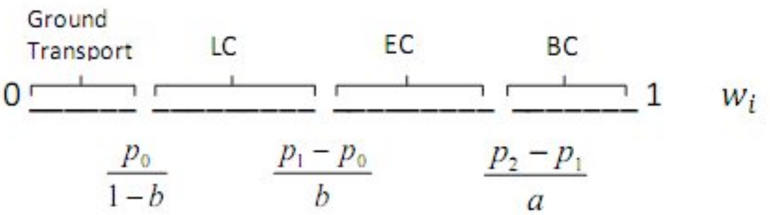

Fig. 2. Passenger i's travel decision on w continuum in the duopoly case

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

$$
\begin{aligned}
q_2 &= \frac{N}{a}(a - p_2 + p_1) \\
q_1 &= \frac{N}{ab}\left[ap_0 + bp_2 - (a+b)p_1\right] \\
q_0 &= \frac{N}{b(1-b)}\left[(1-b)p_1 - p_0\right]
\end{aligned}
\qquad \textbf{(6)}
$$

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

$$
\begin{aligned}
\pi_{FSA} &= \frac{N}{a}\left[(a - p_2 + p_1)(p_2 - c_2) + \frac{\left[ap_0 + bp_2 - (a+b)p_1\right](p_1 - c_1)}{b}\right] \\
\pi_{LCC} &= \frac{N}{b(1-b)}\left[(1-b)p_1 - p_0\right](p_0 - c_0)
\end{aligned}
\qquad \textbf{(7)}
$$

Both airlines know the true values of $c_j, a, b,$ and N. LCC sets p_0 and FSA sets p_1 and p_2 so as to maximize their respective profit functions. Although a dynamic game with incomplete information might be more appropriate to analyze strategic interaction between 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

$$\frac{\partial \pi_{FSA}}{\partial p_1} = \frac{N}{a}\left[(p_2 - c_2) + \frac{ap_0 + bp_2 - (a+b)p_1}{b} - \frac{(a+b)(p_1 - c_1)}{b}\right]$$
$$\frac{\partial \pi_{FSA}}{\partial p_2} = \frac{N}{a}\left[(a - p_2 + p_1) - (p_2 - c_2) + (p_1 - c_1)\right] \quad \textbf{(8)}$$
$$\frac{\partial \pi_{LCC}}{\partial p_0} = \frac{N}{b(1-b)}\left[((1-b)p_1 - p_0) - (p_0 - c_0)\right]$$

From **(8)**, when we equalize the partial derivatives to zero, we get the equilibrium prices,

$$p_1^* = \frac{c_0 + 2(c_1 + b)}{3+b}$$
$$p_2^* = \frac{2c_0 + (1-b)(c_1+b) + (3+b)(a+b+c_2)}{2(3+b)} \quad \textbf{(9)}$$
$$p_0^* = \frac{2c_0 + (1-b)(c_1+b)}{3+b}$$

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

$$q_1^* = \frac{N}{2ab}\left[\frac{2ac_0 + b(3+b)(a + c_2 - c_1) - 2a(1+b)(c_1+b)}{3+b}\right]$$
$$q_2^* = \frac{N}{2a}(a - c_2 + c_1) \quad \textbf{(10)}$$
$$q_0^* = \frac{N}{b(1-b)}\left[\frac{(1-b)(c_1+b) - (1+b)c_0}{3+b}\right]$$

Finally, the equilibrium levels of airline profits are given by

$$\pi_{FSA}^* = \frac{N}{4ab(3+b)^2}\left\{\begin{matrix}2\left[c_0 + 2b - (1+b)c_1\right]\left[2ac_0 + b(3+b)(a+c_2-c_1) - 2a(1+b)(c_1+b)\right] + \\ \left[b(3+b)(a-c_2+c_1)\right]\left[2c_0 + (1-b)(c_1+b) + (3+b)(a+b-c_2)\right]\end{matrix}\right\}$$
$$\pi_{LCC}^* = \frac{N}{b(1-b)(3+b)^2}\left[(1-b)(c_1+b) - (1+b)c_0\right]^2 \quad \textbf{(11)}$$

A numerical example

An example could be helpful in highlighting the results. 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 BC service 30% better than EC service ($a = 0.3$).[8] 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 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. A 30% increase in c_1 decreases the share of air travel only by 4%. Different values of a lead to different allocations of FSA passengers between EC and BC but have 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 ($b = 0{,}2$).[9] In the duopoly equilibrium, the share of passengers travelling by air doubles to 74%, the market share of FSA drops to 53%, EC and BC fares fall by 47% and 33%, respectively, compared to the monopoly case. LCC gains almost half of the air travel market (47%) by pricing its seats 37% lower than FSA's EC fare. FSA's profit is higher than LCC's, partly because of attracting higher income passengers with BC product, but it is only one fourth of the monopoly profit.

Figs 3 and 4 illustrate how 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 diminishing LCC cost advantage. An increase in LC unit cost leading to a higher LC fare allows FSA to increase its profit margin without the risk of losing passengers to LCC. Actually, as Fig. 4 shows, FSA gains market share in this case since LCC share responds strongly a change in the cost ratio.

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[8] 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 average values of all passenger valuations, so their estimates would be more forgiving.

[9] 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 6. 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.

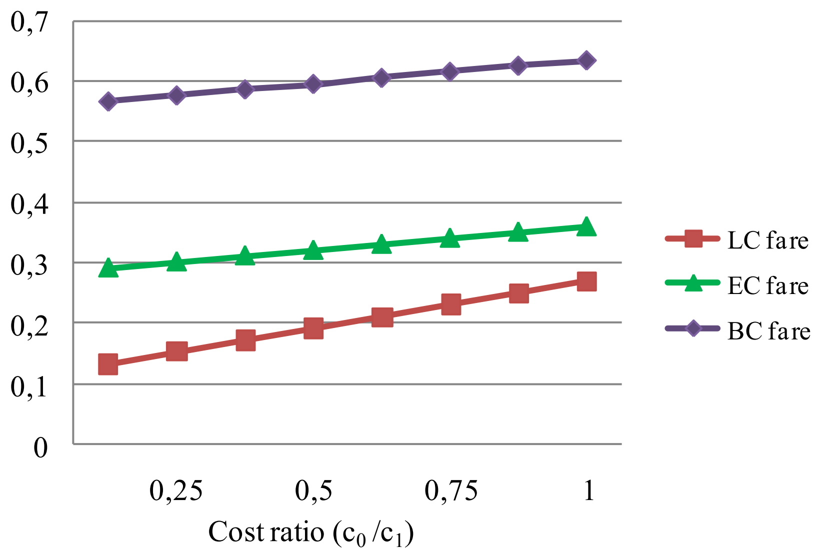

Fig. 3. Equilibrium fares under different LC – EC unit cost ratios

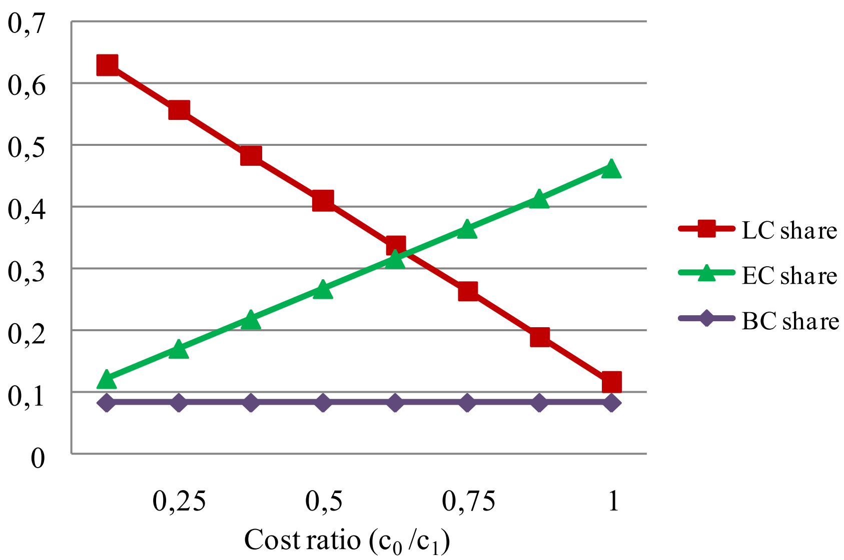

Fig. 4. Equilibrium passenger shares of airlines under different LC – EC unit cost ratios

IV. Discussion

LCCs around the world obsessively try 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.[10] Fare for either service depends on LC and

[10] This doesn't mean that LCC is not attractive for business travellers. Even a business traveller might be "low" or "high" income. See Footnote 4.

EC unit costs and the disutility of flying in LC, b. A decrease in LC's unit cost c_0 enables LCC to gain market share by lowering its price. Some of the new LCC customers will be those who would otherwise travel by ground transport but the rest will come from FSA's EC passengers. 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 LCC's price cut. Consequently, demand for EC falls and LCC's profit increases at the expense of FSA's. The same mechanism works in FSA's favour if c_1 drops relative to c_0.[11] When 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 LC unit cost, as can be seen in Fig. 4.

The other major variable shaping the competition between LCC and FSA, b, is a measure of substitutability between EC and LC. Fig. 5 shows the response of 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. 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 more robust LC demand and higher LCC profit while EC demand and FSA profit fall. In fact, when passengers consider LC as a very close substitute for EC (when b is close to 0) and LCC has significant cost advantage, EC service becomes loss making and FSA model cannot be sustained in the equilibrium. In this case, the only option for 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 disappearance of FSAs on intra-EU routes in the future and some FSAs' recent move of shifting domestic capacity to their low fare – low service subsidiaries in developing countries.[12]

[11] O'Connell and Williams (2006) find that a 30% reduction in EC fare, closing the price gap between LC and EC, would cause two thirds of LCC passengers switch to an FSA in India.
[12] Jet Airlines in India has been channelling its domestic capacity to its LCC subsidiary. Turkish Airlines has recently started doing the same in Turkey.

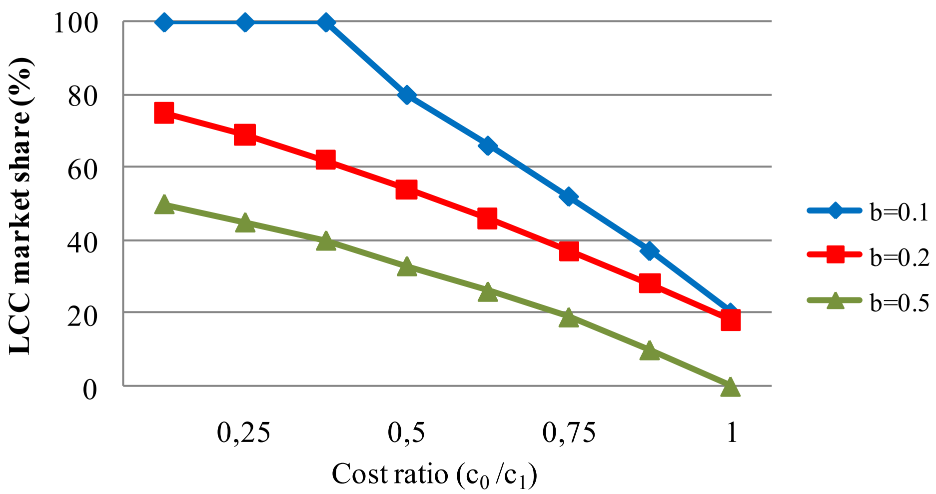

Fig. 5. LCC share of air travel as a function of *b* under different LC – EC unit cost ratios

The role b plays in the model is consistent with actual experience. 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.

Lastly, the share of passengers using air travel depends on LC fare, which in return is determined in the model by the values of c_0, c_1 and b. A decrease in any one of them 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 air travel demand as fares would fall and the effect would be equivalent to an increase in income.

V. Conclusion

In this article, we study the competition between two different airline business models, FSA and LCC. Specifically, we analyze the effects of LCC entry to a domestic air travel market previously monopolized by FSA. We show that following the penetration of LCC, 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. 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. The model can also explain part of the variation in LCC market share across countries as long as LCC cost advantage and/or quality disadvantage show differences between countries.

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