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DOES AIRPORT REGULATION BENEFIT CONSUMERS?

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ABSTRACT

Airport regulation is aimed to impose price caps or other schemes on services supplied by airports to airlines that use them. However, it is not clear that regulation benefits the final consumers, the passengers. In the context of a very simple model, this paper finds out that this doesn't always happen, and that passengers may be worse off with price capping than in an unregulated equilibrium. Besides, the paper provides an insight of the results of other regulation approaches (other than price caps) that have been suggested for airports.

RESUMO

A regulação dos aeroportos tem como objectivo a imposição de preços máximos (entre outras formas de regulação) aos serviços que estes fornecem às companhias aéreas. Não é, contudo, claro, que a regulação beneficie os consumidores finais, os passageiros. No contexto de um modelo muito simples, este paper conclui que isso nem sempre acontece, e que os consumidores podem ficar prejudicados com a regulação. Além disso, são analisados e comparados os resultados de outras formas de regulação, que têm vindo a ser sugeridas para os aeroportos.

1. THE PARTICULAR CHARACTERISTICS OF AIRPORT REGULATION

The regulation of many utilities, such as telecommunications, postal services, or electricity, aims to benefit the users, who are a large number of individual consumers. On the contrary, the regulation of airports, come to directly benefit a small number of large firms, the airlines, sometimes with much more market power than the airports themselves. Then, the obvious question here is if consumers are – or are not- indirectly better off with regulation.

It is true that airports impose individual charges on passengers, and maybe these should be the ones to be restricted. However, regulation doesn't reach, direct or indirectly, individual charges, but, directly, only airside activities, and, indirectly, retail and other revenues.

Besides, little has been written on airport regulation, when comparing to other services. Two reasons may account for it. First, airport regulation, as an issue, came later than electricity or telecommunications. Second, it may be questioned if an airport is a universal service obligation. This depends on the substitutes for flights. In small countries, like Portugal, trains or buses may conveniently substitute airports for domestic travel. But as for continental or transcontinental journeys, as well as for large countries, there is no alternative to flights.

The aim of this paper is to access, in the context of a simple model, to what extent airport regulation benefits the final consumers, the passengers, or if regulation constraints, such as price caps, are rather increasing airlines profits, rents passing from airports to these large firms.

To find out which benefits passengers get from airport regulation, it is obviously important to choose appropriate regulatory schemes. Within the same context, I analyse the implications of alternative approaches to regulation, including de-regulation, as has been questioned lately[1][1].

First I examine the implications of price capping for consumers and welfare, using unregulated equilibrium as a benchmark. Price capping has the most widely used policy for of regulating airports. Then I try to access alternatives to usual marginal cost price capping, namely, a welfare maximization approach. Finally, other approaches are tested, within the same model.

[1] See Starkie (1999)

2. Presentation of the model

In order to bring out results that are easy to read and compare, the model should be as simple as possible, though it should, of course, capture the characteristics of the airports industry.

On the demand side, it makes sense to give way for competition. So I suppose there are two airlines, i and j, supplying the same service, which is a variable number of flights, in a given period of time, starting and ending at the same airports. The two airlines maximize their profits on these flights only. This is quite restrictive, but is a necessary simplification of the model. Besides, the product is homogeneous, and airlines compete on quantity, in a simple Cournot game.

Let y_i be the number of passengers of airline i, supposing that each flight has the same number of passengers, and p the price per passenger and per flight. The inverse demand for flights has a linear form:

$$p = a - (y_i + y_j)$$

As the product is homogenous, costs should be similar for both airlines, and marginal costs are supposed to be constant. Costs are long run ones, in order to capture the airports capital costs. Constant marginal costs for airlines may not be a very reasonable hypothesis in the long run, though the leasing of aircrafts has smoothed increasing expenses associated with long run expansion, and derived from high capital costs.
Being P_i defined ahead, the expression of profits for each airline is:

$$\pi_i = (a - (y_i + y_j))\, y_i - cy_i - P_i\, y_i$$

I consider only one airport, indifferently, the arrival or the origin one. The airport has several sources of revenues, namely, those coming from passenger charges, and directly paid by passengers, those from airside activities (landing, take-off, parking, handling of passengers), which are paid by airlines, and those resulting from passengers' expenditure in retail and other services in terminals.

I purposely ignore the individual charges imposed to passengers, as they aren't, as referred above, neither directly nor indirectly, subject to regulation. So, if the airport has zero profits, it means that it earns only profits derived from these revenues. The revenues from retail and other services are, however, considered.

Let the price of airside activities be denoted by P. As for retail activities, I consider their price as a price cost margin, v, per passenger, and, so, don't include these costs. In order to eliminate unnecessary variables, the price cost margin is equalized to the unit. Airport's revenues are, then

$$R_a = P(y_i+y_j) + v\,(y_i+y_j),\ \text{with } v = 1$$

Finally, in the long run, airport costs have been considered as increasing (Starkie, 1999). This situation is very different from the decreasing costs case that has characterized many utilities as natural monopolies. I use a very simple long run cost function, which yields increasing and linear marginal costs:

$$C_a = (y_i+y_j)^2\,/2$$

Therefore, airports profits may be written as:

$$\pi_a = P(y_i+y_j) + (y_i+y_j) - (y_i+y_j)^2\,/2$$

The industry structure is quite uncommon, with, on one side, one firm, the airport, and, on the other, two airlines. This situation is much near the bilateral monopoly case, and I use Wicksell's suggestions to solve it (see Stahl, 1978). It would be adequate to suppose that the airport, being the only seller, has more market power than the airlines. Then, the first of Bowleys' three cases, which is, indeed, the Wicksell case, and in which the seller determines the price, seems to be adequate.

Of course that this is not a pacific issue, and other ways of solving the equilibrium might be used. In the Wicksell case, the buyer maximizes its profits and finds a demand for the input, while the seller sets the input price, maximizing his profits with this demand function.

In this model there are two buyers, the airlines. They must solve first their competition Cournot game, in order to find the demand for the airside activities, y(P). Then the airport determines the input price, P.

3. UNREGULATED EQUILIBRIUM

This solution is established as a benchmark, though it is also interesting as an issue itself, because de-regulation is one of the points in discussion in what concerns airports[2].

Airlines first compete in quantity, maximizing their profits. With their reaction functions, which depend on each other's quantity and on the input price, P, they find their demands for the input. Adding them, with $y = y_1 + y_2$, and solving for P, this demand is:

$$P = (a-c) - 1.5y$$

Then the airport maximizes its profits using this demand and, so, sets the input price, P. With this price of airside activities, the other variables may be computed, and are presented below in table 1.

Consumer surplus (CS), for a linear demand function, was determined in the following way:

$$CS = \int_0^y (a-y)\, dy - (a-y)y,$$

using the solution for y. Total profits (TP) include, of course, the airlines' and the airport's profits. Finally, total welfare (TW) is the sum of consumer surplus and total profits.

TABLE 1: UNREGULATED EQUILIBRIUM SOLUTIONS

y	1/4 (a-c+1)	$\pi_1 + \pi_2$	$1/32((a-c+1)^2$
P	5/8 (a-c)-3/8	CS	$1/32(a-c+1)^2$
p	3/4a+1/4(c-1)	TP	$5/32(a-c+1)^2$
π_a	$1/8(a-c+1)^2$	TW	$3/16(a-c+1)^2$

[2] There is a good deal of information about the regulation of airports in the UK, provided online by the CAA (Civil Aviation Authority), and by the IEA (Institute of Economic Affairs). For other European countries, I was unable to find evidences. As for Portugal, the INAC (Instituto Nacional de Aviação Civil), through its president, told me that several regulation regimes are now being analyzed, but none was implemented yet.

4. PRICE CAPS

Price caps have been used in the regulation of most of European utilities. The question here is which price cap should be appropriate to the airports case. Usually, price cap determination involve an initial price, or set of prices, as a departure basis, and an adjustment mechanism. This applies to airports.

However, as De Fraja and Iozzi (2000) point out, the adjustment mechanism has deserved much more attention in literature than the initial price. In this case there is no need of adjustment mechanisms, as the model is set on a static comparative basis. So, the setting of the initial price becomes the relevant question. De Fraja and Iozzi (2000) argue that these initial prices were those prevailing before regulation, following or accompanying utilities' privatization. This means they were the state monopoly prices. Putting the matter in a very simple way[3], state monopoly prices would ideally equal marginal cost, if it is constant or increasing, or average cost, in the case of natural monopolies.

As it was referred above, it is likely that airports' costs are increasing in the long run, so marginal cost pricing is the appropriate price cap.

Airside activities' price is capped up to the marginal cost of these activities, which makes, in the model, P = y.

Now, airlines know the price cap, so their costs are fully determined. Maximizing their profits they set the values of y, p and P, and the other relevant variables follow. Results are shown in table 2.

TABLE 2: PRICE CAP SOLUTIONS

y	2/5 (a-c)	$\pi_1 + \pi_2$	$2/25\ (a-c1)^2$
P	2/5 (a-c)	CS	$2/25\ (a-c1)^2$
p	3/5 a+2/5c	TP	2/25 (2a-2c+5)(a-c)
π_a	2/25 (a-c+5)(a-c)	TW	2/25 (3a-3c+5)(a-c)

Comparing both situations we get an insight of what might happen to welfare variables if de-regulation, by price cap abolition, was to be implemented.

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[3] Tirole and Laffont (1999) provide an ample discussion on marginal or average cost pricing, and the question is too old and too well known to be discussed here.

The results depend crucially on the difference between the parameters a and c. The following proposition may be stated:

Proposition 1:

a) The abolition of price caps towards a free market situation always increases the airport's profits, as should be expected.
b) If a-c>5/3, consumer surplus, total profits and total welfare become smaller with de-regulation. Also, airlines' joint profits are lower.
c) On the contrary, if a-c<5/3, consumers and, in general, society benefit with the abolition of price caps. And so do airlines.

This proposition, as well as the next ones, may be proved by the simple comparison of results. Here, welfare changes depend crucially on the difference between the reservation price, a, and the airlines' marginal cost, c. In fact, a-c reflects the difference between the willingness to pay, for any consumer, for a flight, and the additional cost of carrying an extra passenger.

If this difference is large enough (say, larger than a certain amount, 5/3), regulation by price capping improves welfare, consumer surplus and the airlines profits. There is no trade off between consumers' and airlines' interests, and the airport's firm is the only one to see its profits diminished. As consumers' valuation for flights is high enough, and/ or marginal cost is low enough, demand will rise as a result of the price cap, pushing down the output price. With a smaller price and a larger number of passengers, consumers get better off. Also, airlines profits benefit from the fact that the input price, P, is smaller, and this contributes to increase them, together with the fact that c is (comparatively) small enough, and, so, making Py an important share of the costs.

However, there is a possibility (a-c<5/3) that consumer surplus and total welfare, as well as total profits may be higher with de-regulation. In this case, the price of flights rises, and the number of passengers decreases. This happens because passengers' valuation for flights is now lower, compared to its cost, and the input price is not so important in the airlines' costs. Thus, and within the context of this simple model, *de-regulation not always benefits consumers, and not always improves welfare*. In fact, there must be a certain condition for the value of a-c so that this may happen.

The intuition here is that airlines' strategies affect consumers. A price cap reduces airport's revenues and profits, and airports *would* choose a lower y. But with the price cap, airlines' costs are lower, and this increases the demand for flights, and, so, for airside services. When airport maximises its profits it faces a higher demand but a lower price, P. That's why the result will depend on the difference a-c, that states the magnitude of the change in airlines demand.

5. Welfare maximisation

Will there be a better solution than price capping on the base of marginal costs? This question may be addressed in another way. One may think if the marginal cost price is the best price cap, or if some other objective, such as welfare maximization may provide another input price, which is preferable.

The answer is, of course, positive. But, then, why isn't this solution more widely accepted, or even questioned? This makes a point for analyzing the results of a welfare maximization approach, which may be modeled as follows.

Adding airlines' input demands, we get total demand for airside activities, which is:

$$y = 2/3\ (a-c-P)$$

Using the above expression, consumer surplus, total profits and total welfare may be expressed depending only on P:

$$CS = 2/9\ (a-c-P)^2$$

$$TP = 2/3\ (1+P)\ (a-c-P)$$

$$TW = 2/9\ (a+3-c+2P)\ (a-c-P)$$

This latter is the expression to maximize, in order to find the input price that yields the greatest welfare that is possible. The result is:

$$P = 1/4\ (a-c) - 3/4$$

This requires that a-c> 3, so that P may be positive. For a smaller difference between passengers' reservation price and airlines' marginal cost, there is no positive solution for P.

Why should this solution differ from marginal cost pricing? Welfare maximization should bring price equal to marginal cost. And, indeed, the results show that the flights price per passenger is equal to the sum of the airport's and the airlines' marginal costs.

While the price cap approach in section 4 equals the input's price to the input's marginal cost, which is quite different.

The average cost for airside activities is, at the solution for y of welfare maximization:

$$y/2 = 1/4\ (a-c+1)$$

It is easy to check that

$$P = \text{average cost airside activities} + 1$$

As the average cost for retail activities equals the unit, the input price, P, equals total average cost, including both activities.

Thus, welfare maximization yields a value for the input price such that this is equal to the sum of the average costs from airside and retail activities. This means that the airport has zero profits in all activities, and experiments losses in airside activities. This may happen because welfare involves the sum of consumer surplus and total profits, no matter whose are these profits. They may represent large sums of profits for airlines and losses for the airport.

It would not be efficient to implement a policy in which the airport has to compensate losses in airside with retail activities. This is a good point for not using a simple welfare maximization. However, this objective may be corrected by a constraint that makes airports have zero profits in airside activities.

The approach is, then one of welfare maximization, but allowing airports a positive profit in retail activities. This is close to the Ramsey-Boiteux model of cost-of-service regulation (Tirole, 1999), only that the case isn't one of natural monopoly, and that there are no profits at all for airside activities. Profits come from retail activities' revenues, and these are closely related to airside services revenues, but shouldn't account for consumer surplus.

If airside profits are equalized to zero,

$$Py = y^2/2 \quad \text{and} \quad P=1/2\ y$$

Substituting P by this condition in the expression of total welfare:

$$TW = -y^2 + y\ (1+a-c)$$

Maximizing this expression, there solutions for P, y and the other variables, as expressed in Table 3.

> <u>*Proposition 2*</u>: A welfare maximization with the constraint that the airport's airside activities have zero profits, when compared with a marginal cost price capping, proves to be a better approach. In fact, it increases consumer surplus and total welfare, while letting the airport earn some profits from retail activities.

TABLE 3. WELFARE MAXIMIZATION WITH ZERO AIRSIDE ACTIVITIES PROFITS: SOLUTIONS

y	1/2 (a-c+1)	$\pi_1 + \pi_2$	1/8(a-c+1)(a-c-3)
P	1/4 (a-c+1)	CS	$1/2\ (1/2(a-c+1))^2$
p	1/2a	TP	$1/8\ (a-c+1)^2$
π_a	1/2 (a-c+1)	TW	$1/4\ (a-c+1)^2$

As for the firm's profits, the respective changes depend on the value of a-c. If a-c>3.2, the airport is better off with the price cap. Airlines prefer the price cap for a-c<6.8. Total profits will be higher with welfare maximization if a-c< 0.7.

Allowing the airport get profits only from retail activities may, however, be an incentive to improve retail activities and miscarry the quality of airside services. Though the number of consumers is the same in both services, it is quite likely that the elasticity to quality is much larger for airports' retailing than for airside services, as passengers often aren't even aware of the quality of these latter (Starkie, 1999).

6. OTHER APPROACHES TO REGULATION

6.1. Joint venture of retail activities

One of the proposals concerning de-regulation could be a demerge of retail activities, which would be owned by a separate company, established as a joint venture between the airport and the airlines, as proposed by Starkie (1999). This would, and according to the same source, mitigate the effects of a simple de-regulation, that brings more profits for the airport, and less profits for the airlines.

The question here is if this approach will simply redistribute profits, and, as Starkie (1999) argues, or if there are also effects on consumers.

In an unregulated equilibrium setting, as the purpose was to de-regulate, I have tested a fifty percent distribution of retail profits between the airport and the airlines, so that airports profits become now:

$$\pi_a = P(y_i+y_j) +0.5 (y_i+y_j) - (y_i+y_j)^2 /2$$

And each airline's profits:

$$\pi_i = (a -(y_i + y_j)) y_i +0.25(y_i+y_j) - cy_i$$

The framework is the same o section 2, with different expressions for profits and, consequently, for input demand functions. Input demands are parallel to the unregulated equilibrium ones, but displace upwards by 1/6.

TABLE 4: JOINT VENTURE FOR RETAIL ACTIVITIES.

y	1/4 (a-c)+3/16	$\pi_1+\pi_2$	$1/32\ (a-c)^2+0.1(a-c)+0.64$
P	5/8 (a-c)+1/32	CS	$1/32\ (a-c)^2+0.5(a-c)+0.2$
p	$3/4^a+1/4c-3/16$	TP	$1/64\ (a-c)^2+0.3(a-c)+0.13$
π_a	$1/8\ (a-c)^2+3/16(a-c)+0.7$	TW	$1/36\ (a-c)^2+0.3(a-c)+0.2$

<u>*Proposition 3*</u>: A joint venture for retail activities, when compared to the unregulated equilibrium solution, reduces consumer surplus and total welfare. Airlines' profits are higher, and airport's profits lower, as expected.

As their average and marginal revenues displace upwards, airlines demand for airside activities will be higher. For the airport, this means an increase in revenues and, also, in costs. But revenues also experiment a decrease because of the lower share of retail activities. The airport will finally choose a smaller y, and, consequently, airlines will charge a higher price. Then, there follows that consumer surplus decreases.

The input price, P, is higher, but airports revenues decrease. Besides, there is a cut in revenues from retail. Though costs are smaller, airport's profits are now smaller too. Airlines' profits increase, but not much. There are more revenues, but y is lower. Then, total profits decrease, as well as total welfare.

Though this scheme of joint venture for retail activities is apparently only a matter of profits distribution between the airport and the airlines, the analysis proves not to be so. *There is an effect on airlines' revenues, which affect their demand for the input and, then, affect passengers and total welfare*.

This result doesn't differ if the share of retail services profits is any other one. With any share, k and 1-k, for airlines and airports, consumer surplus and total welfare are lower in the joint venture situation[4].

6.2. Limited government oversight

This approach includes two criteria for airside activities price determination. The compensation criterion, in which the airport sets costs for the different airside activities, and, then, their price is such that the revenues equal costs. By the residual criterion, all costs and all profits (including airside and retail activities) are computed, and airside activities are, then, set in a way to equal all profits to zero.

The first method brings out zero profits for airside activities, while the second results in the same situation for the set of all activities. However, the first criterion isn't necessarily the same than welfare maximization under constraint as modeled in the precedent section, because this solution involves an welfare maximization for determining the value of y (or of P). And setting simply zero profits for airside services may involve another way of determining y.

7. CONCLUDING REMARKS

The most interesting results of this model may be summarized as follows:

1. Consumers do not always benefit from airport regulation. It depends on the difference between a and c, and doesn't happen if $a-c<5/3$. However, it is interesting to notice that, in this case, airlines, and, if course, the airport are also worse off. Then, there is a net loss of welfare, and not rent transfers.

2. Welfare maximization, with a constraint of zero profits from airside activities, seems to be the best approach to airport regulation. And it isn't always a worse solution for firms.

[4] This is easy to compute, and results may de demanded to the author.

3. Joint venture of retail activities isn't just a matter of profits distribution. Indeed, it changes the whole solution of the model, and makes society worse off, even when compared to an unregulated equilibrium solution.

The model has, of course, its limitations. In particular, hypothesis on airlines' and airports' costs are important for the results obtained.

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