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CEF.UP Working Paper 2010-01

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Maria Cristina Barbot

Centro de Economia e Finanças da UP
www.fep.up.pt

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Cristina Barbot

Affiliation: CEF.UP Faculty of Economics of Porto

Phone number: 351225571218

Fax number: 351225505050

*Emai*l: cbarbot@fep.up.pt

Address: Faculdade de Economia

Rua Roberto Frias, 4200 – 464 PORTO PORTUGAL

* I thank Fundação da Ciência e Tecnologia for financial support

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Abstract

This paper addresses the case of complementary services with vertical relations. Using the example of airport handling activities, we develop a model to investigate the effects on welfare and competitiveness of four different handling market situations. We find out that the usual Cournot result on welfare when firms compete in complementary goods is verified unless there are efficiency gaps between the firms, or if vertically related firms also compete on the same market. We also find that the presence of a horizontally integrated firm may lead to market foreclosure. Moreover, we add a few remarks on regulatory issues, where we show that regulation may be pointless or even anti-competitive. In particular, we show that Council Directive 96/67/EC, while intending to increase competition, may lead to anti-competitive situations and consumers surplus decreases.

Keywords: Complementary goods competition; airport handling; vertical relations.

1. Introduction

In Europe, ground handling services used to be supplied by airports and sometimes by self-handling airlines as well. Since 1996 this market registered fundamental changes, as a consequence of Council Directive 96/67/EC, which is part of the air transport de regulation measures package. The implementation of this Directive gave way to the entry of new handling operators, competing with the former airport and/or airline operator.

The European Commission aimed at a liberalisation of the services of ground handling that would increase competition and, consequently, welfare. However both the presence of vertical relations in the market and the fact that the handling firms compete with the airport in what regards other facilities (runways, aircraft parking) in complementary goods introduce changes in the market relations. Consequently, the outcome of such measures is not the usual result of more competition but rather a much more complicated set of results.

This paper analyses the effects of the ground handling market de-regulation. It starts with the basic case involving a single airport operator, which was the most common situation previous to the Directive. This situation is first compared to a market where ground handling is only supplied by *n* independent operators. Then an airport firm performing the same service is added to the *n-1* independent handling operators. Finally, to this market situation, a self handling airline[1] is added. In all these types of markets the effects on consumers surplus and all firms' profits are compared to the basic situation.

The main theoretical background of this paper lies on vertical relations in air transport and competition with complementary goods. Vertical relations literature was analysed elsewhere[2]. In this paper vertical relations between airlines and airports and handling operators are combined with horizontal competition in perfect complements. Airlines use aeronautical services, as landing and take-off, parking and others (hereafter, services A) and ground handling services (hereafter, services H). As a flight must be operated with both types of services, ground handling and aircraft services are perfect complements. When two firms

[1] The case of an airline providing services to itself and to others was studied elsewhere (Barbot, 2009a) and proved to be anti-competitive as it leads to market foreclosure.

[2] See Fu and Zhang (2009) and Barbot (2009b) for a survey on vertical relations applied to air transport.

supply complementary services, the market is oligopolistic but Cournot competition works with firms competing in prices and best response functions are negatively sloped. This is what makes this case different from ordinary oligopoly competition. As a result, complementary goods competition may decrease welfare instead of increasing it, as it happens in the case of substitutes' competition.

Cournot (1883) had already found this result. Using the case of two monopolists producing two complementary goods (copper and zinc) Cournot (1838) showed that this the market solution achieves higher prices (and lower quantities) than the prices a monopolist producing the two goods would set. Spence (1976) analyses entry and expansion in the case of complementary goods competition and concludes that this type of goods should be supplied by multiproduct firms. In a spatial setting, Matutes and Regibeau (1988) express the intuition of the monopoly *versus* oligopoly results: if one firm produces both goods, a decrease in the price of one of them will increase both demands, which does not happen in the two firms' case. Then, monopoly profits are higher than oligopoly joint profits. Economides and Salop (1992) consider two different brands of each of two different but complementary components, resulting in four inputs that can be combined to produce a composite good. They analyse two different cases: (i) parallel vertical integration of two firms, one of each type of complementary input that sell the respective composite good and (ii) one-side joint price setting, when one of the complementary components is price capped and sold to the other firms the produce complementary components. They conclude that in both cases prices are lower when compared to independent ownership, which confirms Cournot (1883)'s result. Another important point of this paper is that the authors conclude that prices are higher with joint ownership than with independent ownership if and only if the downstream market goods are close substitutes[3].

As for more recent papers, Buchanan and Yoon (2000) consider this situation as a "tragedy of the anti-commons", opposing to the well-known "tragedy of the commons", and provide a graphical and analytical model for competition with complementary goods, obtaining Cournot (1883)'s result. Gabszewicz et al (2001) analyse a situation of consumer complementary goods, but admitting that each good can be consumed separately though joint consumption

[3] This result suggests a symmetric one, that the result also may hold if in downstream market goods are complementary and the upstream market goods are substitute. However, the analysis of this case is beyond the scope of this paper.

adds utility to that of the sum of separate consumption. They conclude that for strongly complementary goods a unique symmetric equilibrium exists. Complementarity has also been recently analysed with potential competition and of sequential sales. Packalen (2009) examines the case of two complementary monopolists inducing entry on each other's market and shows that cooperation or integration may decrease entry and, consequently, consumer welfare. Feinberg and Kamien (2001)'s paper deals with the case of sequential sales, where complementarity is analysed together the hold-up problem.

This paper applies the "tragedy of the anti-commons" to the airports handling market. However, it provides insights that may be applied in similar markets and its results are by no means confined to airports' activities. Particularly, it applies to cases of two complementary input markets with one of the firms supplying both goods but competing with rivals in one of them, and of one of the downstream firms supplying one of the inputs. As an example, the activities of assembling, calibrating, storing and distributing fruit are perfect complements, and there may be one firm doing all these operations (as it happens in some co-operatives), or by different firms. In ports complementary services such us pilotage, towage and cargo handling may be operated by the port authority, or by firms with concessions, or by both. Tourism provides another example regarding the complementarity of tourist packages (flights plus hotel), with hotels, charter airlines and tourism operators belonging to the same or to different firms.

The framework of this paper applies to many other situations where one or, alternatively, different firms, produce components that are assembled to produce a good or service. In particular, it is adequate to analyse decision of outsourcing or internalising activities.

Among the referred literature this paper is similar, in its structure and aim, to Economides and Salop (1992). However there are substantial differences between the two. Regarding the model's structure, these authors also use linear demands but zero costs for all firms, while I consider constant marginal costs in the target market (ground handling) and fixed costs in its complement, in order to assess the impact of concession fees, which is relevant whenever vertical relations are involved. The two papers also differ in the market structures they analyse. In terms of Economides and Salop (1992)'s model, this paper always assumes a single firm (an airport) on one of the complementary components (aeronautical services) and n (and not only two) firms on the other one (ground handling). Moreover, this paper also admits the possibility of the monopolist in the first market operating in the second one, while competing with n independent operators (case 3), as well as the case of one composite good (downstream) firm competing in one of the complementary inputs market, along with independent operators and with the monopolist in the other complementary input.

Our main findings are that the Cournot result on the consumers surplus decrease, when several firms compete with a single firm in complementary goods in an upstream market: (i) does not depend no the number of competitors, (ii) also leads to market foreclosure if the single firm in one of the markets also operates in the other market, and (iii) does not hold if a downstream firm also operates in the upstream market. However, there may be an increase in consumers surplus if the independent operators achieve a higher level of efficiency than the airport. We examine some important implications of our analysis for regulation issues and conclude that, depending on the market situations analysed in the paper, regulation may be pointless, may improve welfare or may even make consumers worse-off.

The paper is innovative since, and as far as we am aware of, the market for ground handling and its horizontal and vertical connections, had not been analysed before. It is also innovative in its theoretical development, as it models complementary goods competition but in a vertical relations two-stage game, to which are added (i) n firms selling one of the goods, (ii) one of the competing firms (the airport) selling both goods and behaving as a monopolist in the other market, and (iii) one of the downstream firms (airline) operating in the market of one of the complementary goods. Thus the internalisation of both horizontal and vertical externalities is analysed. Also, the implications on regulation are rather surprising and provide important insights for policy issues.

The paper is organised as follows. In section 2 we analyse the purpose and the statements of Council Directive 96/67/EC. In section 3 adequate models for each of the four cases are developed and results are analysed. Section 4 draws the main implications of the previous results for political (regulatory) issues. Section 5 presents a few concluding remarks.

2. The market for handling services and Council Directive 96/67/EC

The Directive imposes that in each member state's airports beyond a certain dimension (2 million passengers or 50000 tonnes of freight) there must be at least two handling operators, and at least one of them must be independent both form the airport and from the dominant carrier.

The purpose of this liberalisation process is to achieve more competition. Indeed, the Directive states that "if the number of suppliers of groundhandling services is limited effective competition will require that at least one of the suppliers should ultimately be independent of both the managing body of the airport and the dominant carrier" (CEU, 1996).

Authorities often follow the idea that more competition increases welfare. This is true for a large number of situations. But exceptions exist and sometimes more competition is not welfare-enhancing or, at least, it does not increase consumer surplus. And if consumers should be the main beneficiaries of European Union liberalisation measures, consumers surplus is an important indicator of the success of these measures.

Though the Directive only imposes one independent handling operator, many handling firms have entered the market since this legislation was implemented. Currently the market for ground handling in European airports may include four types of operators: airports' handling companies, independent handling operators, self-handling airlines, which operate services exclusively for their own flights, and so-called third party handling companies, airlines that also supply services to other airlines. Liberalisation legislation still differs among the member states, according to the number of allowed independent operators, the limits to market access (fully liberalised or through concessions), and the size of airports where liberalisation is implemented. In the EU-15, in 2007, the number of each type of operators varied across countries and airports. Airport and independent handling included from two (LIS, FRA, MAD) to 11 (LHR) firms, while the number of handling airlines varied from one (LIS, LGW, CDG) to six (LHR). The most frequent case includes only one airport handling operator and few independent and airline operators (ARC, 2009). In the new member states numbers were not very different, but with fewer independent and airline operators.

3. Model and results

3.1. Basic model

In the basic model there are two airlines, A_1 and A_2, which sell a service (a seat in a flight), in quantities q_1 and q_2 and at price p. Their services are identical and market demand takes the simple form of $p = (a-q)$, $q = q_1+q_2$. Airlines pay a price to use the airports' facilities, which may be divided into two types of services: ground handling (hereafter, service H), with price P_h, and other aeronautical services (use of runway, parking, hereafter named service A), with price P_a. Assuming zero costs for all other inputs, p may be taken as a price cost margin except for airports' costs. Airlines' profits are expressed by:

$$\pi_i = (a-q_i-q_j)q_i - (P_a+P_h)q_i, \text{ i=1,2}$$

Airlines play a trivial Cournot game in the second stage[4]. The second stage solution yields the demand for airside services, $q(P_a ,P_h)= \frac{2}{3}(a - P_a - P_h)$. To solve the first stage I use Cournot (1883)'s procedure, as modelised by Buchanan and Yoon (2000) for complementary goods.

Cournot (1883) proposed a model of complementary goods with two monopolists supplying each one of the goods. In his model, demand is equal to $P = a-bq$, where P is the sum of prices P_1 and P_2 a consumer has to pay to acquire both goods. Then $P_1 + P_2 = a - bq$, and, solving for P_1, the resulting expression is introduced in firm 1's profit expression. The same procedure applying to firm 2, best reply functions are found and the game is solved. The case of complementary goods turns to be a price competition model with strategic substitutes.

In the present model, Cournot (1883)'s procedure is easily adapted to the vertical market. Demand for both airside facilities, $q = \frac{2}{3}(a - P_a - P_h)$ is inverted, yielding

$P_a + P_h = a - \frac{3}{2}q$. Solutions for the first and then for the second stages depend on the upstream market situation. In this market there may be one or more operators. We assume that the service A has only fixed costs in the amount of K, as this type of operations mainly use

[4] Results are presented in Appendix 1.

basic infrastructure, while services H have a constant marginal cost of c. The explicit inclusion of this cost allows for analysing efficiency in handling operations.

3.2. Handling market situations

Case 1: One airport handling operator

The airport provides both services and maximises its profits:

$$\pi_A = (P_a+P_h-c)(q(P_a+P_h)) - K$$

The airport sets its best prices for two complementary activities. These prices are strategic substitutes, and, as the two services are performed by a single firm, their "best response functions" have a higher (in absolute value) coefficient than if they were performed by one firm. This is because the airport internalises the interdependence between the two services. Thus, best response functions are:

$$P_h = \frac{1}{2}(a-c) - P_a \text{ and } P_a = \frac{1}{2}(a-c) - P_h$$

However, the solution of the system of best response functions is not determined. As the airport supplies both services it may set a high price in one of them and a low price on the other, and conversely. A set of solutions for prices yields the same quantities. Then the airport has to solve the maximisation of $\pi_A = (P- c)(q(P))$ and then divide P into the two prices. The solution for prices is internal to the airport and is not relevant here. One possible solution that is compatible with the best response functions is a pair of prices that result in the same profit margin for both activities, setting $P_a+P_h=P$ and $P_a=P_h - c$. Solutions for prices yield all the other solutions. Only the solutions for the airport's profits, π_A, for each airline's profit, π_i, for P_a and P_h (or their sum) and, in order to check for consumer welfare, for q, are relevant for our analysis.

Case 2: Handling is supplied by n independent handling operators

The second stage yields, as in the previous case, the demand for airside services, $q = \frac{2}{3}(a - P_a - P_h)$. But now there are n independent handling operators, all with the same constant marginal cost c, which means that their quantities will be identical. Each one of these operators also pays the airport a concession fee, fK, where it is assumed that f is a share of the airport's fixed costs. This makes sense as the ground handling firms use part of the airport's installations and equipments, this part corresponding to f.

I follow the Cournot (1883) model for complementary goods, but with n firms in one of the markets. Inverting the demand for airside services and solving for Ph, the demand for handling operations is $P_h = a - \frac{3}{2}q - P_a$. Each handling firm has a profit of:

$$\pi_{Hi} = (a - P_a - c - \frac{3}{2}(q_i - (n-1)q_j))q_i - fK$$

In order to obtain the demand of all independent operators we assume they play a Cournot game amongst themselves, and then compete with the airport. Maximising operator i's profits and making $q_i = q_j$ and $q = nq_i$, yields $q = \frac{1}{3}n\frac{a - c - P_a}{n+1}$. Substituting q in $P_h(q, P_a)$, we get $P_h(P_a)$, the airlines best reply function. Proceeding in an identical way with the airport's profits, $\pi_a = \frac{2}{3}(a - P_h - P_a)P_a - (1-f)K$, $P_a(P_h)$ is found and solutions for P_a and P_h and for all other variables are computed.

Comparing with the previous case, where the airport supplied the handling services, it happens that, with n independent handling operators:

1. q is smaller and p higher;
2. $P_a + P_h$ is higher;
3. π_A is lower as well and so are the airlines' profits;
4. $\pi_A + n\,\pi_{Hi}$ is smaller than π_A in the previous case.

Notice that the airport's profits will only be higher if $nfK > \frac{(a-c)^2}{n+1}$. But each operator had then to pay, at least $\frac{(a-c)^2}{n(n+1)}$, which exceeds its profits for any *n>0*. No handling operator would pay such fee. Moreover, the sum of the airport's plus the *n* handling operators' profits is lower than the airport's profits in case 1, which clearly shows that such a fee could not exist.

These results allow us to establish the following Proposition:

Proposition 1: Compared to the situation of handling performed by one airport, when *n* independent operators supply ground handling, but neither the airport nor any airline do so, social welfare is inferior whatever may be the number of handling operators.

Proof: The proof is straightforward following the results above. If quantities are smaller and prices higher, consumer surplus falls. Airport and airlines earn fewer profits, and the sum of all firms' profits is thus inferior.

With competition in the handling services market, P_h falls but the airport is competing in prices that are strategic substitutes. The airport will then increase P_a, giving way for a rise in airlines' costs (despite the fall in P_h), and prices. This proposition meets the result that Cournot (1883) had already stated, and that was met by other authors, as explained in the previous section, on the internalisation of the products complementarity when one firm produces both of them, and on the welfare losses of strategic substitutes' competition. Moreover, vertical relations show that the loss of gains extends to the downstream market airlines and, through them, to consumers.

Council Directive 96/97/EC (CEU, 1996) explicitly forbids sate members from limiting the number of independent handling operators to fewer than two for each category of groundhandling services. Our results show that the number of handling operators is irrelevant as for any *n>1* welfare decreases with the introduction of these firms.

Corollary 1: If the independent firms achieve a higher level of efficiency in their operations, a market with n independent operators can make consumers better-off if the number of operators, n, exceeds a certain value, $n > \frac{a - c_1}{c_1 - c_2}$.

Suppose that the airport, when operating as a monopoly has a constant marginal cost of c_1 in activities H, while the same variable, for each handling operator, is of c_2 and $c_2 < c_1$. The solution for q will only be higher in case 2 if $(n+1)c_1 - nc_2 > a$. If this happens case 2 is superior to case 1 in what regards consumer surplus. This condition may be written as: $n > \frac{a - c_1}{c_1 - c_2}$, meaning that consumers surplus increases if there are more than a certain number of handling operators in the market, and that number is inversely correlated with productivity difference (c_1-c_2) and, for a given value of c_1, directly correlated with the market size (a-c_1). The larger the efficiency gap between the airport and independent firms and the smaller the market size, the smaller will be n. Alternatively, the needed efficiency gap, $c_1 - c_2 > \frac{a - c_1}{n}$, depends positively on the market size and negatively on the number of independent operators, for a given c_1.

Case 3: Airport and n independent firms as handling suppliers

However, the most common case of ground handling supply in the European Union is a mix of the two previous ones, often adding an airline handling operator. We shall now examine these two cases, starting with the groundhandling market with one airport operator competing with n-1 independent firms.

There are n firms in the handling market, n-1 independent operators and the airport handling firm. As in the precedent cases demand for services H and A is $q = \frac{2}{3}(a - P_a - P_h)$ or $Ph = a - \frac{3}{2}q - P_a$. Independent operator i has profits of:

$$\pi_{Hi} = (a - (\frac{3}{2}(q_i - (n-2)q_j - q_a) - P_a - c)q_i - fK \ ,$$

where q_a stands for the airport's quantity and q_j for any of the other handling operators' quantity. The airport's profits are:

$$\pi_a = (a-(\frac{3}{2}((n-1)q_i - q_a) - P_a - c)q_a + P_a(\frac{2}{3}(a - P_a - P_h)) - n(1-f)K .$$

The airport maximises profits in q_a and P_a, while the other operators maximise profits in q_i. Solving the three first order conditions, solutions for upstream prices are P_h=c and P_a $=\frac{1}{2}(a-c)$.

Proposition 2: With one airport and *n* independent operators in the handling market, the airport sets a price for airside services that forecloses the handling market.

Proof: In the demand function for handling services, both P_a and P_h have the same coefficient, as services are perfect complements. It follows that only their sum, *P*, influences upstream demand. Let *P** be the price for all airport services in case 1 and *q** the resulting demand. As these values are the solutions for a single operator, *P** and *q** maximise profits in the upstream market. The airport may set any value of P_a such that P_a+P_h equals *P**. As P_a increases P_h decreases, but the airport increases profits while doing so as it has all the demand in services A and only part of the demand in services H. Then it will set a P_a that makes it have the highest profits form services A, even reducing the profits in services H. Its profits are maximised when $P_h = c$.

If $P_h = c$, the airport internalises services A and H's margins and quantities will be higher. If $P_h > c$, the other handling operators will be active, and part of the handling operations will not be internalised, resulting in a smaller demand. By setting P_h=c the airport forecloses the market and gets all profits both from services A and H.

Then case 3 cannot be sustainable and but will fall in case 1, unless constraints are imposed on the airport's behaviour.

These constraints consist in inducing the airport to act in the two markets as two separate firms. This would make case 3 identical to case 2. The trade-off between P_a and P_h was implicitly recognised by authorities. In fact, Council Directive 96/67 EC establishes, in article 4, that: "Where the managing body of an airport, the airport user or the supplier of groundhandling services provide groundhandling services, they must rigorously separate the accounts of their groundhandling activities from the accounts of their other activities, in accordance with current commercial practice" (CEU, 1996). This limitation might offset the previous result of market foreclosure and was probably included in the Directive with this aim. But the separation of accounts does not seem to be enough as the airport may proceed accordingly but set its prices as any set of different firms in collusion does. ARC (2009) reports that some stakeholders complaint of unfair competition from airports' handling and that the separation of accounts is not sufficient to eliminate this bias. These complaints suggest that our results for case 3 are verified.

If the market depicted by this case persists in many airports there must be limits to the airport's decision-making that allow for the independent operators to co-exist with the airport handling. The first limit is regulation. If P_a is capped, then the airport, while competing in complementary services, will set a higher P_h, which allows for the handling operators to remain in the market. Regulation issues have further implications that are discussed in section 4. The second limit may be any downstream market power in the upstream market, when airlines also operate in this market. This is case 4.

Case 4: One airline, the airport and n-1 independent operators in the handling market

In this case, one of the airlines (for example, A_1) operates the handling of its own flights.

In the downstream market, A_1's profit is now $\pi_1 = (a-q_1-q_2-P_a-c)q_1$, while A_2 has the same profit as before. Solving the downstream market, q_2 is the derived demand for handling services, $q_1 = \frac{1}{3}(a-2c-P_a+P_h)$, $q_2 = \frac{1}{3}(a-c-P_a-2P_h)$ and q_2+q_1 =

$\frac{1}{3}(2a - c - 2P_a - P_h)$ the demand for airside services. In the handling market there are *n* operators, *n-1* independent firms and the airport. Each independent operator has profits of:

$$\pi_{Hi} = ((\frac{1}{2}(a - P_a - c) - \frac{3}{2}(q_i - (n-2)q_j + q_a))q_i - fK ,$$

where q_a stands for the airport's quantity. The airport's profits are the sum of those obtained in the handling market, with demand q_2, and those earned in services A, with demand q_1+q_2:

$$\pi_a = (\frac{1}{2}(a - P_a - c) - (\frac{3}{2}((n-1)q_i - q_a))q_a + P_a(\frac{1}{3}(a + c - P_a - 2P_h)) - n(1-f)K .$$

Proceeding as in case 3, all the solutions are computed. The result may be summarised in the next Proposition:

Proposition 3: With one airline doing its own handling, and the airport competing in the handling market with *n-1* independent operators, the market is not foreclosed and, compared to the case where only the airport operates handling, consumer surplus increases.

Proof: The proof follows from the solutions in the Appendix. As the quantity is higher and the price is smaller consumers are better-off.

Compared to case 1, as A_1 does its own handling q_1 will increase and q_2 will decrease. The airport faces now a smaller market for handling, where it competes with other operators and a larger market for other airside services, where it is a monopoly. Then it is not profitable to reduce P_h in order to increase P_a, because there would be a significant reduction in its demand for activities A.

As the whole quantity increases, consumers will be better-off than with a monopolist airport in the handling market. Notice that this result derives from the trade-off between the two markets, and from the effect of reducing quantities in market for services H. Therefore the self-handling airline must have a market share that is large enough to induce the airport to limit P_a so that the increase in quantities allows for an increase in its profits. Moreover, the improvement of consumers surplus is also due to the vertical internalisation of externalities by the airline, while eliminating the double marginalisation. But this result goes exactly against Council Directive 96/67/EC that states that the self handling airline will be allowed to operate if it has not carried more than 25% of the airports' passengers in the previous year. Intuitively, the Directive opposes to a self handling airline with a large market share. But it is precisely its large market share that offsets the negative effects on market foreclosure and consumer surplus.

Also compared to case 1, A_1's profits increase, as expected, as it internalises the handling of its own passengers, and both the airport's and A_2's profits are smaller. As in case 2, the airport's profits would only increase if each handling operator plus the airline would pay it a fee that exceeds the profits of the *n-1* operators.

4. Regulation issues

Our previous results have important effects on price regulation of airports. Regulators should have in mind the results of this particular type of competition between complementary goods, as regulation may lead to several distortions.

Airport regulation may have an incidence on (i) only activities A, or (ii) activities A and the fees airports charge to handling operators, or (ii) activities A and H.

(i) If only P_a is regulated, the findings of this paper show that there are important implications on regulation matters since a cap on the value of P_a leads to a higher value of P_h and the final effects depend on the handling market structure:

a) In case 1, with a capped P_a the airport will push P_h up to the point where the sum of P_h+P_a maximises its profits. Then regulation seems to be pointless.

b) In case 2, capping P_a will lead to a higher P_h and higher profits for the independent handling operators, while the airport will be worse-off and airlines probably not affected by regulation since that, with an increase in P_h, the sum of P_a+P_h may remain the same. Then regulation may not benefit consumers but handling operators at the expenses of the airport. As an example, the single till, when compared with the dual till, will negatively affect not only airports' but also handling operators' profits.

c) In case 3, the airport cannot push up P_a and foreclose the market. Then regulation has a positive effect and is pro-competitive. However, with a capped P_a, P_h will be higher and regulation will not have any effects on consumers surplus.

d) In case 4, the capping of P_a will have the same effects of case 2, only that attenuated by the fact that the demand for handling is smaller and the self-handling airline, not by affected by the increase in P_h, will be better-off. The bias is still against the airport, but now the self-handling airline also benefits, as well as the independent handling operators.

(ii) If the concession fee is regulated as well, there are no effects in the quantities prices, but only in the shares of upstream market profits. This conclusion is valid under a dual till. With the single till, the revenues of the concessions to handling operators are included in the computation of the revenue per passenger, and, the higher this revenue, the higher will be P_a. This means that, in case 2, with the single till, the higher the concession fee that independent operators pay, the higher will be P_a and the lower will be P_h.

(iii) If both airside and handling activities are price capped, regulation authorities should pay attention to this trade-off, even under a dual till regime, as they may benefit (or penalise) the independent operators and the self-handling airlines or the airport, depending on the cap on each activity.

5. Concluding remarks

This paper shows that Council Directive 96/67/EC, while failing in understanding the complementarity in the relationships between handling and airside activities, fails in its aims. Though designed with the belief that more firms in the market means more competition and consumers better-off, it does not achieve the expected improvements in consumer surplus and on competition.

When a certain number of independent operators substitute the airport in handling activities, consumers surplus only increases if the new firms are able to achieve a level of efficiency that is enough higher than the airport's. The necessary efficiency gap will depend positively on the market size and negatively on the number of independent handling firms.

If the airport also operates handling market, together with other operators, it will foreclose the market by increasing the price of airside activities. This will not happen if this price is capped.

If one airline does its own handling, surprisingly consumer surplus increases. This is due both to the internalisation of vertical externalities by the airline and to a smaller handling market.

Finally, the paper shows that the complementarity of prices has important implications in airports regulation.

Appendix 1: Solutions for case 1 to 4

Case 1

$$P_h + P_a = \frac{1}{2}(a+c);\ q = \frac{1}{3}(a-c);$$

$$\pi_A = \frac{1}{6}(a-c)^2; \pi_1 = \pi_2 = \frac{1}{36}(a-c)^2.$$

Case 2

$$P_h = \frac{1}{2(n+1)}(a+c(2n+1)); P_a = \frac{1}{2}(a-c);\ q = \frac{1}{3(n+1)}n(a-c)$$

$$\pi_A = \frac{n}{6(n+1)}(a-c)^2 - (1-f)K; \pi_1 = \pi_2 = \frac{n^2}{36(n+1)^2}(a-c)^2$$

$$\pi_{Hi} = \frac{(a-c)^2}{6(n+1)^2} - \frac{fK}{n}$$

Case 3

$$P_h = c; P_a = \frac{1}{2}(a-c);\ q = \frac{1}{3}(a-c)$$

$$\pi_A = \frac{1}{6}(a-c)^2; \pi_1 = \pi_2 = \frac{1}{36}(a-c)^2$$

Case 4

$$P_h = \frac{6c(2n-1)+5a}{3(4n+1)}; P_a = \frac{(a-c)(6n+1)}{3(4n+1)}\ q = \frac{2(a-c)(3n+2)}{9(4n+1)}$$

$$\pi_A = \frac{72n^2+6n+47}{27(4n+1)^2}(a-c)^2 - (1-f)K; \pi_1 = \frac{(3+2n)(6n-1)}{27(4n+1)^2}(a-c)^2$$

$$\pi_2 = \frac{4(n-1)^2 (a-c)^2}{9(4n+1)^2}; \pi_{Hi} = \frac{50(a-c)^2}{27(4n+1)^2} - \frac{fK}{n}$$

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Centro de Economia e Finanças da UP
Rua Dr. Roberto Frias 4200-464 Porto | Tel. 351 225 571 100 | Fax. 351 225 505 050 | **www.fep.up.pt**

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