Airline Market Power and Airport Regulation

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1 Introduction

An airport is generally considered to be in a situation to exploit market power especially if no comparable airport is located in the appropriate surrounding area. This assumption has posed a basic principle in recent literature discussing airport pricing and regulation as for instance in OUM ET AL. (2004), ZHANG & ZHANG (2006) and ZHANG & ZHANG (2010).[1] Airports are treated as monopolies and airlines are presumed to view the airport´s landing fee to be parametric.

Market power could, however, shift from the airport to airlines as pointed out in BUTTON (2010). The author points out that the basic principle in current research in airport pricing principles, to treat the airport as a monopoly, could be considered to be the upper limit. Prices and fees discussed in recent literature on airport regulation would apply only if the airport is indeed able to exploit market power and set monopolistic prices. But how would the airport behave if it was stripped of its market power? By how much is the airport willing to reduce the landing fee i.e. what is the lower limit of the airport charge?

This paper aims to relax the assumption of airport market power and bestows airlines monopsony power. Airlines are able to compel the airport to enter into negotiations on the landing fee. After reviewing the classic monopoly-outcome discussed in OUM ET AL. (2004) in section 2, their model is altered in section 3 to suit the new setting. The airport´s pricing behaviour concerning the landing fee and the prices for concession services as well as the airport´s capacity decision is studied in four different market situations. The first case is a classic monopsony where only one airline with market power operates to and from the airport in question. Next, the airport serves two airlines with monopsony power. On the lines of BRUECKNER & VAN DENDER (2008) two duopoly-cases and a fourth case with

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[1] Since this paper deals with a certain regulatory framework, we refrain from giving an overview on airport regulation. An recent in depth literature review is provided by ZHANG & CZERNY (2013).

many arlines are considered. First a Cournot-duopoly is discussed followed by a case where the two airlines compete in Stackelberg fashion. The last case involves a large number of airline companies. The Stackelberg-follower is now considered to be a group of many airlines operating to and from the given airport. These four cases will see a gradual decrease in the airlines possibilities to exploit monopsony power as the number of airlines increase.

Finally, section 4 discusses possible consequences of airline monopsony power for airport regulation. Two forms of regulation are considered, namely the rate-of-return regulation and the price-cap regulation each in both single-till and dual-till layout. As both forms are designed to countervail monopoly power on the part of the airport, inverting the basic setting might possibly reduce the need for regulatory actions. This paper finds that a general reduction in regulatory measures in the airport industry, however, would by no means offer the appropriate solution. Quite the contrary: Regulators have to be rather well informed about the market situation on the given airport prior to any decision on whether and how to take regulatory actions.

2 Airport as Monopolist: Model by Oum, Zhang & Zhang

In general, an airport catering for commercial airlines operates two sectors: aeronautical services and concession services. Aeronautical services are mainly infrastructure related such as the use of runways, terminals, technical services and air traffic controlling facilities which are essential for a fully functional airport. Concessions are mostly granted to private operators in order to provide passengers with retail services. These services generate both operating and capital costs which the airport seeks to cover by collecting landing fees from the airlines and by setting suitable prices for concessions which are in effect paid by the passengers. Passengers are willing to pay a fixed “full price” for their flight which contains the airline fare and the cost of delay due to congestion. Passengers and airlines incur higher expenditures due to extra time spent on the ground or in the air. The level of congestion is determined by the flight volume and the capacity which implies congestion can reach zero with an appropriately low flight volume and/or high capacity. Expenditures for concession services are not part of the total generalised travel costs of the passengers but are considered a separate expenditure. Consequently the full price ρ perceived by the passengers determines the demand for airport facilities or the flight volume Q with the following property:

$$\frac{\partial Q}{\partial \rho} < 0$$

The authors in OUM ET AL. (2004) assume that the airlines can fully pass landing fees on to their passengers; hence, any alteration of the landing fee is fully reflected in the airline fare. The perceived full price is then determined by the airline fare excluding the airport charge, landing fees and costs of congestion.

The authors consider the other airline charges to be exogenous and since the model considers only airport pricing they reckon the flight volume can be determined by the landing fee for one flight P and the sum of both airline delay cost and passenger delay cost due to congestion D.

The level of delay cost is determined by the flight volume Q and the capacity of the airport K so that $\mathrm{D} = \mathrm{D}(\mathrm{Q}, \mathrm{K})$ applies. The cost of capital of the airport is denoted by r and the operating costs of aeronautical services by $C(Q)$. The delay cost function is differentiable in Q and K and the airport operating cost function in Q.

$$\frac{\partial D}{\partial Q} > 0 \qquad \frac{\partial D}{\partial K} < 0 \qquad C' > 0$$

The price for concession services u determines the per flight demand X for those services so that $\mathrm{X} = \mathrm{X}(\mathrm{u})$ and the cost for providing the concession services is denoted by $c(X)$. The following properties apply:

$$X' < 0 \qquad c' > 0$$

In order to simplify, the profits from concession services per flight are denoted by R and the per flight consumer surplus from concession purchases plus concession profits by V in appropriate cases.

2.1 WELFARE-MAXIMISING AIRPORT

The authors first introduce an airport maximising social welfare. It serves as a benchmark and allows comparisons with a profit-maximising airport. As described in relevant literature social welfare is considered to be the sum of consumer surplus and producer surplus:

$$SW = \int_{\rho}^{\infty} Q(\rho)d\rho + PQ - C(Q) - Kr + Q\left[\int_{u}^{\infty} X(u)du + uX - c(X)\right]$$

The first integral represents the consumer surplus passengers gain from the flight itself and the second integral is the consumer surplus passengers gain from purchasing concession services. The authors presume the airport to be subject to a budget constraint preventing it to post any losses. In this case the airport will calculate as follows:

$$\max_{P,u,K} \int_{\rho}^{\infty} Q(\rho)d\rho + PQ - C(Q) - Kr + Q\left[\int_{u}^{\infty} X(u)du + uX - c(X)\right]$$

$$s.t.\, PQ - C(Q) - Kr + Q[uX - c(X)] = 0$$

The corresponding Lagrangean function is then differentiated with respect to the landing fee P, the price for concession services u and the cost of capital of the airport r. In case of the differentiation with respect to P and K the terms associated with concession services are substituted with V and R:

$$V = \int_{u}^{\infty} X(u)du + uX(u) - c(X(u))$$

$$R = uX(u) - c(X(u))$$

The first-order conditions yield the following pricing principles:

$$P_W = C' + Q\frac{\partial D}{\partial Q} + \frac{\lambda}{1+\lambda}\frac{P}{\varepsilon} - \frac{V + \lambda R}{1+\lambda} \quad (1)$$

$$u_W = c' + \frac{\lambda}{1+\lambda}\left(\frac{X}{-X'}\right) \quad (2)$$

$$r_W = -Q\frac{\partial D}{\partial K} \quad (3)$$

where subscript W indicates a welfare maximising airport.

Concerning the landing fee (1), the welfare maximising airport imposes a markup and a markdown term to the social marginal cost of one flight. The first term represents the marginal operating cost of the airport and the second the marginal congestion cost that all other flights incur. These two terms represent the social marginal cost of one flight. The third term contains the elasticity of demand for air travel with respect to the landing fee.

A monopoly would shift its prices to a point where demand is elastic. An airport which aims to maximise social welfare, however, is not expected to exploit its market power. The third term involving demand elasticity is indeed bounded by $\frac{\lambda}{1+\lambda}$. Whether the multiplier λ - set to ease the effect of the third term - is positive or negative depends on the budget constraint. OUM ET AL. (2004, P. 224) state that an unconstrained welfare-maximisation leading to financial losses for the airport would yield a positive λ and an unconstrained welfare-maximisation leading to financial surplus yields a negative λ. The authors, however, consider only the case where $\lambda > -1$ as the opposite would lead to counterintuitive pricing principles. Finally, the markdown term involving the concessions sector is the weighted average of the concession welfare V and the concession profits R.

The price for concession services (2) also includes the same term $\frac{\lambda}{1+\lambda}$ as the landing fee. The welfare maximising airport seems to ease the otherwise monopolistic prices to a level at which zero profits are expected, similar to the price for aeronautical services. The authors, nevertheless, believe the airport would still set profit maximising prices for concession services. They point out, that publicly owned airport authorities contract private, profit maximising companies to operate the concession services. By auctioning the concessions the airport is able to capture locational rents and use these to subsidise airside operations, visible in the fourth term of the landing fee (1). Thus, the alleviating term is then expected to drop and resemble the notion of a profit-maximising airport (6).

Finally, the welfare maximising airport sets the capacity (3) at a socially efficient level where the marginal benefit of capacity expressed as reduction in congestion costs equates to the marginal cost of capacity r.

2.2 PROFIT-MAXIMISING AIRPORT

In their second case the authors consider an unregulated airport which aims to maximise the total profit from both the aeronautical and concession services.

$$\max_{P,u,K} PQ - C(Q) - Kr + Q[uX - c(X)] \tag{4}$$

Differentiating the profit maximisation with respect to the landing fee P, price for concession services u and the capacity K yield the following pricing principles:

$$P_\pi = C' + Q\frac{\partial D}{\partial Q} + \frac{P}{\varepsilon} - R \tag{5}$$

$$u_\pi = c' + \left(\frac{X}{-X'}\right) \tag{6}$$

$$r_\pi = -Q\frac{\partial D}{\partial K}, \tag{7}$$

where subscript π denotes a profit maximising airport.

The authors point out that the landing fee (5) set by the profit maximising airport is socially inefficient. The two first terms still form the social marginal cost for one flight as in the case of a social welfare-maximising airport (1). It is the third term which reflects the airport´s market power. The fourth and last term is a markdown equal to per-flight concession profits which reflects the complementarity between aeronautical and concession services even in the case when the airport seeks to maximise profits.

STARKIE & YARROW (2000, p. 2) point out in this respect, that concession services can shift the potentially monopolistic landing fees towards lower ones. Since an increased flight volume at the airport will yield a higher demand for concession services, the airport can gain from significantly higher profits from the concession sector because of locational rents.[2] In order to attract more flights the airport will then have to lower the landing fees. Lower revenues from aeronautical services are, however, compensated by higher profits from concession services. According to the authors the unregulated profit maximising airport then has an incentive to lower landing fees towards a more socially efficient level due to the concession profits. Due to demand complementarity the airport would only be expected to set monopolistic prices for concession services. The pricing principle for the concession price (6) in OUM ET AL. (2004) is indeed higher than the marginal costs for providing the services.

Furthermore, the profit maximising airport will set its capacity (7) at a socially efficient level just as in the case of a welfare maximising airport. The authors, however, note that the efficient level of capacity is conditional on the flight volume Q. Where the equation for the level of capacity is socially efficient the landing fee set by a profit maximising airport is not. As a result the capacity levels of the two airports are different even though both follow the same capacity setting principles. The equations (3) and (7), nonetheless, imply that both airports achieve an efficient traffic/capacity ratio in order to satisfy the condition to keep capacity at level where the social marginal benefits equate the marginal cost of capacity.

The landing fee at an unregulated profit maximising airport is higher than at a welfare maximising airport. The extent of the difference is determined by three factors, namely the Lagrangean multiplier λ, the price elasticity of demand ε and by the proportion of concession profits R on total concession welfare V.

By definition, the total surplus from concession services V must be greater than the concession profits R. The smaller the difference between the surplus of the concessions and the profits is, the smaller the difference between the landing fees of each airport is going to be. In other words the difference depends on how well the concession operators can skim the surplus from the market.

An elastic demand will weaken the markup term bringing the two airport charges closer to each other. Similarly, the greater λ, the less power is left within the alleviating terms and the closer the two prices will be.

Nevertheless, the profit maximising airport is expected to set too high prices from a social viewpoint. Considering the pricing principles of a welfare maximising airport to be the desired benchmark and the one of a profit maximising airport to represent the top of the possible price spectrum, the question is how low the airport will set its prices when it is stripped of its market power and confronted with only one customer, a monopsonist.

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[2] This argument is also shared by STARKIE (2002, P.70).

3 Airline Market Power and Airport Pricing

In this chapter an altered model of the one set up by OUM ET AL. (2004) is introduced in order to account for the assumption that market power has shifted from the airport to the airlines. The model of airline and airport behaviour is based on a sequential game with two stages. During the first stage the airlines decide on their flight volume which is no longer determined by the perceived full price $\rho = P + D$ but is in fact determined on the market for air travel and particularly due to competition between the airlines. In the second stage the airport charge is determined. The airport can no longer ask for monopolistic prices as airlines are willing to consider alternative airports should they find the landing fee to be too high. The airport is aware of the airlines´ outside option and is therefore willing to enter into negotiations with each of them.[3] The airlines will stress their flight volume as the main factor in determining the airport charge and the airport has to consider how efficiently it is able to operate under the current capacity level. Hence, the landing fee P is determined by the flight volume Q and capacity K. The function to determine the landing fee is differentiable in Q and K.

$$\frac{\partial P}{\partial Q} > 0 \qquad \frac{\partial^2 P}{\partial Q^2} \geq 0 \qquad \frac{\partial P}{\partial K} > 0$$

With these alterations the model is going to be applied to four different market situations. First an airport which serves only one airline followed by a case where two airlines fly to and from the airport and compete in a Cournot fashion. Next an airport with two airlines competing in Stackelberg manner is discussed and finally airport pricing is analysed with the assumption that the Stackelberg follower is a group of many competitive airlines.

3.1 MONOPSONY

In contrast to a competitive market with many players a monopsonist is the only buyer of a specific good. The quantity the monopsonist buys is the total amount traded in the market. Any further output will remain unsold and therefore the producers will adjust their supply to the needs of the monopsonist. This is where the monopsonist can utilise its position as it dictates the output level of the suppliers. The price paid by the monopsonist is determined by the quantity it purchases, since generally suppliers will have to adjust their prices according to the cost they incur for producing the demanded amount of goods. The problem a monopsonist faces is the question on how many units to purchase in order to maximise the net benefit, the value of the good less the price it pays. In his attempt to maximise the net benefit the monopsonist will purchase a lower quantity in order to obtain a lower price.

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[3] Further arguments are provided by STARKIE (2012).

By how much the price will be pushed is determined inversely by η, the elasticity of supply. In the context of this paper η would represent the elasticity of supply for airside services with respect to the total flight volume.

$$\eta = \frac{P(Q)}{Q}\frac{\Delta Q}{\Delta P} \tag{8}$$

The supply elasticity can be found in the marginal expenditure ME which determine the quantity purchased by the monopsonist.

$$ME = \frac{\Delta E}{\Delta Q}$$

$$\frac{\Delta E}{\Delta Q} = P(Q) + Q\frac{\Delta P}{\Delta Q} \tag{9}$$

$$\frac{\Delta E}{\Delta Q} = P(Q)\left[1 + \frac{1}{\eta}\right]$$

If the supply curve is elastic, -implying a moderately upward slope-, the markdown will remain small. In that case the monopsonist has only limited market power. If the supply elasticity is infinite, meaning η is infinitely large, the supply curve is again flat reducing the case to the one of a competitive market. The monopsonist will have no market power whatsoever. Should the elasticity of supply, however, be inelastic, represented by a small η and an accordingly ascending supply curve, considerable market power would be granted to the monopsonist and the markdown would be significant.

Whether an airline could exploit its position as the only one operating to and from the airport in question is then determined by the supply elasticity of an airport. Supply is determined by the ascending section of the marginal cost curve above the average cost. How steep or flat is the supply curve of an airport? Runways and terminals are surely dominating elements of total costs. Both represent at least partially sunk costs since an already paved runway cannot really be sold to another airport. The same applies for the terminal building. Elements such as runway lighting, ILS-facility, security infrastructure and computer hardware for terminal operations and air traffic control may possibly be able to be sold but they do not represent the highest part of total cost. Supply curve then seems to be rather elastic considering the runway and terminal building only. Operating an airport, however, is far from limited to paving runways and constructing terminals. Both are not as much affected by altering flight volumes, but the extent of the already mentioned security services, air traffic control, as well as emergency facilities such as fire stations and fire engines, fuelling facilities, apron management services, baggage operations, de-icing facilities, bus transfers and much more are indeed influenced by the flight volume. Custom-made equipment and the necessity for specially trained staff in many of these services and operations means the flight volume will have a significant impact on the size of these expenditures. Operating close to the capacity limit could also potentially imply high cost dependent on the flight volume as managing large numbers of passengers and aircraft demands for personnel and facilities in the appropriate quantity and quality.

As much as the runway and the terminal imply a strongly elastic supply all the factors mentioned above point out, that supply does not seem to be infinitely elastic. The supply curve could indeed feature an at least moderately ascending shape, possibly increasing with the flight volume. Exploitation of monopsony power can therefore not be ruled out.

The alterations to the original model by OUM ET AL. (2004) discussed in the introduction of this chapter yield the following optimisation problem for the airport:

$$\pi_{AP} = P(Q,K)Q - C(Q) - Kr + Q[uX(u) - c\big(X(u)\big)] \tag{10}$$

The subscript AP denotes the airport's profit function in order to distinguish the airport´s optimisation problem from the one of the airlines. Differentiating π_{AP} with respect to the flight volume Q, the price for concession services u and the capacity K yields:

$$\frac{\partial \pi_{AP}}{\partial Q} = \frac{\partial P}{\partial Q}Q + P(.) - C' + R = 0$$

$$\frac{\partial \pi_{AP}}{\partial u} = QuX' + QX - Qc'X' = 0$$

$$\frac{\partial \pi_{AP}}{\partial K} = \frac{\partial P}{\partial K}Q - r = 0$$

The first order conditions can then be transposed to deliver the following pricing principles:

$$P_m(.) = C' - R - \frac{\partial P}{\partial Q}Q \tag{11}$$

$$u_m = c' + \left(\frac{X}{-X'}\right) \tag{12}$$

$$r_m = \frac{\partial P}{\partial K}Q \tag{13}$$

The subscript m is to identify the pricing principle to be the one of an airport dealing with one airline utilising its monopsony power.

The two first terms - the extra cost of one additional flight less the concession profits - of the landing fee (11) are similar to the case where the airport utilises market power. The airport seems, however, to grant a discount determined by the marginal revenues. By how much the landing fee changes with one extra flight is strongly connected to the outcome of the negotiations between the airport and the airline. The discount is conditional to the total flight volume Q. The decision of the airline on how many flights to offer to and from the airport in question is going to determine the discount, since it defines the appropriate point along the supply curve of the airport. As pointed out in the introduction to this section, the extent of the monopsony power is connected to η, the supply elasticity. Moving the last term in (11) to the left hand side yields a comparable outcome to (9) and consequently the supply elasticity can be shown in the landing fee.

$$P_m(.) = \frac{C' - R}{1 + \frac{1}{\eta}} \tag{14}$$

Depending on the shape of the supply curve the discount then can vary from non-existent to significant. If supply is elastic the discount will remain small and if supply happened to be infinitely elastic the discount would vanish altogether. Where the supply curve bears a low η, namely where supply is inelastic, the airline can skim a substantial discount. The shape of the supply curve depends on the flight volume and the current capacity level as discussed earlier.

The price for concession services (12) remains unchanged. Setting the price at the profit maximising level will enable the airport to skim maximal profits, which it uses to subsidise the airport charge to keep it as low as possible. Concerning the concession services, all three airports, the social welfare maximising (2), the profit maximising (6) and the current airport follow the same pattern.

The capacity is kept at an efficient level where marginal benefit for the airport is equal to the marginal cost. The pricing principle for capacity (13) indicates that at an airport serving one airline with market power additional revenue gained from expanding the capacity shall not exceed the cost of capital r. Should the airport, however, experience pressure from outside, for example politics, to lower its landing fee in order to attract as many flights as possible it will probably underinvest in capacity. The saved funds out of omitted investments are then used to lower the landing fee even further which implies that at some point subsidies are inevitable in order to balance out the needed but previously dropped investments. The politicians' decision whether to push airport charges even further or not, will possibly be determined by the gain of popularity due to the increased flight level compared to the loss of popularity when the airport needs public funding in order to remain operational. This outcome, however, cannot be recreated in this model and is subject of positive economic theory.

The possibility of a deadlock in the negotiations is, however, not a realistic outcome. In MYERSON & SATTERTHWAITE (1983) the authors introduce a case where the trading parties in bilateral negotiations cannot reach an equally efficient solution for both when the valuation intervals of the two players overlap. An implicit assumption in the discussed model is the inability of both trading parties to prove their valuations to the other party. In this paper, however, the airline is expected to be able to convince the airport of the outside option the airline has to its disposal and the two parties are able to reach a conclusion through negotiations.

3.2 COURNOT DUOPOLY

In the following subsections, two airlines are operating to and from the airport. The question is whether or how the airport is going to adjust its pricing policy. As the flight volume is a key parameter in determining the landing fee it is necessary to analyse how the two airlines will interact. In this subsection the two airlines are assumed to compete in Cournot fashion. Both airlines offer a homogeneous good and have a similar cost structure. Each airline considers the flight volume of its competitor as fixed and both airlines decide simultaneously how many flights to offer. In order to examine the interaction between the two airlines an appropriate model needs to be introduced.

BRUECKNER & VAN DENDER (2008) examine how airlines behave on congested airports. Compared to road traffic, airline operators may internalise some of the congestion cost since every flight not only imposes delay cost on flights by competing carriers but also on other flights of the same carrier. The extent of internalisiation may vary depending on the players on the market and their interaction. Tolls are then needed in order to reach a socially efficient level of congestion. Therefore the authors assemble a model to describe an airport which serves two airlines which compete in Cournot fashion and Stackelberg fashion as well as a case where one airline is a Stackelberg leader and the follower is considered to be a group of airlines competing in Cournot fashion. These insights are incorporated in our model.

Two airlines operate to and from the airport in question. The flight volume of airline 1 is denoted with Q_1 and Q_2 is the flight volume of carrier 2. Passengers are willing to pay a full fixed price ϕ which includes the airline fare and the delay costs passengers incur. These costs per passenger due to extra time spent in congestion is denoted by $t(Q_1+Q_2)$. Delays cause extra time cost for airlines as well, namely $g(Q_1+Q_2)$ per flight. Congestion is determined by the total flight volume Q_1+Q_2 and therefore both functions (t and g) function are subject to the total flight volume. The combined delay cost per flight of passengers and airlines are united as $M(Q_1+Q_2)$. The following properties apply:

$$M' > 0 \qquad\qquad M'' \geq 0$$

Thus, increasing traffic will increase delay cost and the effect is possibly more pronounced when the flight volume increases even further.

The profits of airline 1 are marked by π_1 and the profits of carrier 2 by π_2. The seat capacity per aircraft is denoted with s and the operating cost with τ. For simplicity the authors assume that every aircraft operating to and from the airport in question bear an identical seat capacity and identical operating cost. The two airlines negotiate simultaneously and separately with the airport. The airport will consider its current capacity and the flight volume of each airline when negotiating with each of them. The landing fee for airline 1 is consequently not only determined by its own flight volume Q_1 and the capacity of the airport but also by the flight volume Q_2 of its competitor. $P_1(Q_1, Q_2, K)$ is then the landing fee paid by airline 1 and $P_2(Q_1, Q_2, K)$ the airport charge paid by carrier 2. It is crucial to note, however, that the landing fee is not determined by the total flight volume but both flight volumes separately. These characteristics will have an effect if the flight volumes of the two airlines differ. The profit function of airline 1 takes the following form:

$$\pi_1 = \varphi s Q_1 - M(Q_1 + Q_2)Q_1 - \tau s Q_1 - P_1(Q_1, Q_2, K)Q_1 \tag{15}$$

Differentiating (15) with respect to the own flight volume Q_1 yields:

$$\frac{\partial \pi_1}{\partial Q_1} = \varphi s - [M'Q_1 + M(.)] - \tau s - \left[\frac{\partial P_1}{\partial Q_1} Q_1 + P_1(.)\right] = 0 \tag{16}$$

This first order condition can then be transposed to deliver the pricing principle of airline 1.

$$\varphi_{1_{Cournot}} = \tau + \frac{M'Q_1 + M(.) + \frac{\partial P_1}{\partial Q_1} + P_1(.)}{s} \tag{17}$$

Carrier 2 follows an analogous condition.

Both airlines seem to internalise the delay cost they impose on themselves and both airlines appear to take into account how their output decision will affect their own airport charge but neither considers how their actions will affect the competitor´s delay cost nor the level of the landing fee. The flight volume is indefinable but as stated in the setup both act simultaneously, both incur identical cost and both offer a homogeneous good. Under these conditions the outcome is a symmetric equilibrium. Both set identical airline fares, both offer the same number of flights and therefore both will operate 50% of the total flight volume.

As stated earlier the main factor the airlines will highlight in their negotiations with the airport to determine the landing fee is their flight volume. If both, carrier 1 and 2, offer the same number of flights, neither of the two will have an advantage during the negotiations. The airport will treat both equally as both will have an equal flight volume. They will pay identical landing fees and consequently the landing fee is not determined by the two flight volumes separately but by the total flight volume. Furthermore, an increase or reduction in either of the two flight volumes is going to have the same effect on the price of both airlines regardless which airline made the alteration in their number of flights.

The profit function of the airport is as follows:

$$\pi_{AP} = P(Q_1 + Q_2, K)(Q_1 + Q_2) + (Q_1 + Q_2)[uX(u) - c\big(X(u)\big)] - Kr - C(Q_1 + Q_2) \tag{18}$$

In the case of the price for concession profits and the capacity, the airport is not going to distinguish between the two flight volumes but only considers the total number of flights simplifying the profit function to:

$$\pi_{AP} = P(Q_1 + Q_2, K)(Q_1 + Q_2) + (Q)[uX(u) - c\big(X(u)\big)] - Kr - C(Q)$$

Differentiating π_{AP} with respect to the flight volume of airline 1, the price for concession services *u* and the capacity *K* derives:

$$\frac{\partial \pi_{AP}}{\partial Q_1} = \frac{\partial P}{\partial Q} Q_1 + P(.) + R - C' = 0$$

$$\frac{\partial \pi_{AP}}{\partial u} = QuX' + QX - Qc'X' = 0$$

$$\frac{\partial \pi_{AP}}{\partial K} = \frac{\partial P}{\partial K} Q - r = 0$$

Differentiating the profits with respect to the flight volume of carrier 2 yields an analogous condition.

The first order conditions lead to the following pricing principles:

$$P_{1_{Cournot}}(.) = C' - R - \frac{\partial P}{\partial Q} Q_1 \tag{19}$$

$$u_{Cournot} = c' + \left(\frac{X}{-X'}\right) \tag{20}$$

$$r_{Cournot} = \frac{\partial P}{\partial K} Q \tag{21}$$

The subscript *Cournot* is added to indicate that the above pricing principles derive from an airport serving two airlines which compete in Cournot fashion and the subscript 1 marks the landing fee to be the one for airline 1.

The landing fee (19) for airline 1 and an analogous for carrier 2 is similar to the one derived in the previous case with one single airline. The airport sets its prices at the level of the marginal cost of one additional flight less the concession profits and grants a discount. This discount, however, seems to be reduced by 50%. The discount in the landing fee in the previous case (11) is conditional to the total flight volume Q. In this case (19) the discount is conditional to the flight volume of only one of the two airlines. As both operate half of the total flight volume the pricing principle can be simplified to accommodate either of the two.

$$P_{Cournot}(.) = C' - R - \frac{\partial P}{\partial Q}\frac{1}{2}Q$$

Both airlines are priced according to the above principle. The question remains whether the airlines are still able to exert any kind of bying power. Shifting the last term to the left hand side and introducing the supply elasticity η as in the monopsony case (14) does not seem as manageable in this case. Opposed to the monopsony case (14) where η denoted the elasticity of supply for aeronautical services with respect to the total flight volume, the supply elasticity in this case would only be with respect to 50% of the total flight volume. Controlling only the other half of the number of flights will definitely limit the market power each airline can impose on the airport, possibly even more than 50%. Furthermore, the fact that two airlines operate to and from the airport in question could imply that due to competition the total flight volume is higher than in the previous case with only one airline. A monopsonist keeps the quantity it buys artificially low in order to exploit its market power. As soon as there are two airlines, monopsony power will be limited to a certain extent and the incentive to keep the purchased number of goods artificially low will decrease. As stated earlier the flight level is indefinable but just as the output of a monopoly is generally considered to be lower as of a duopoly competing in Cournot fashion, the number of goods purchased by a monopsonist is likely to be lower than the number purchased by an oligopsony. This could also contribute to reduced market power of the two airlines. Still, each of them operates half of the total flight volume after all which will likely ensure that at least limited bying power remains and the discount will not vanish completely.

The price for concession services (20) remains unchanged. This appears to be reasonable as it allows the airport to lower the landing fee as much as possible. The capacity decision (21) is unaltered as well. The airport still keeps capacity at a level where the cost of capital r equates to the increase in landing fees originating from the last carried out expansion of capacity.

Next to the above symmetric equilibrium outcome the airport might allow only one airline to utilise its runways and terminals. The airport could offer one of the two airlines an exclusive contract. The situation is comparable to the upstream and downstream merger discussed in HART & TIROLE (1990) as the contract would effectively resemble a vertical merger. The airport and for instance airline 1 would agree on an exclusive contract preventing carrier 2 from flying to and from the airport in question. The collaboration between the airport and airline 1 could go as far as a profit-sharing scheme. According to HART & TIROLE (1990) the two togehther could skim high profits due to double marginalisation and remove conflicts of interest over pricing principles. The downside, however, might be lower incentives to improve efficiency on behalf of the subordinate unit. Additionally, it is questionable, whether such an exclusive contract is going to be even approved by competition authorities or if an airport would be in the position to pursuit such an approach since in this paper not the airport but the airlines are expected to have market power. Nevertheless vertical mergers or acqusitions are not entirely theoretical as according to MILMO (2012) Ryanair has stated its interest in buying London Stansted from BAA.

3.3 STACKELBERG-DUOPOLY

Opposed to the previous subsection where the airlines decided simultaneously on their flight volume, this subsection discusses a Stackelberg-duopoly where one airline acts first and the other will respond in the next season.

Again the model by BRUECKNER & VAN DENDER (2008) is used in altered form to investigate the behaviour of the two airlines. Airline 1 is the Stackelberg leader and carrier 2 the follower. The follower will consider the output of the leader as parametric and will choose a suitable flight volume to maximise its own profit in response. Therefore, the profit function of carrier 2 is differentiated with respect to Q_2.

$$\pi_2 = \varphi s Q_2 - M(Q_1 + Q_2)Q_2 - \tau s Q_2 - P_2(Q_1, Q_2, K)Q_2$$

$$\frac{\partial \pi_2}{\partial Q_2} = \varphi s - [M' Q_2 + M(.)] - \tau s - \left[\frac{\partial P_2}{\partial Q_2} Q_2 + P_2(.)\right] = 0 \tag{22}$$

It is important to keep in mind that the landing fee of either airline is no longer determined by the total flight volume. In a Stackelberg duopoly the leader is expected to produce more than the follower. The outcome is thereby not symmetric and therefore the airport will not treat the two airlines equally in the negotiations to determine the landing fee. Both flight volumes will still have an impact on the landing fee either of the two airlines will pay but due to the inequality the function determining the landing fee will transform to $P_1(Q_1, Q_2, K)$ for airline 1 and $P_2(Q_1, Q_2, K)$ for carrier 2.

Next the first order condition (22) is totally differentiated yielding the following:

$$\frac{\partial Q_2}{\partial Q_1} = -\frac{M' + M'' Q_2 + \frac{\partial^2 P_2}{\partial Q_2 \partial Q_1} Q_2 + \frac{\partial P_2}{\partial Q_1}}{2M' + M'' Q_2 + \frac{\partial^2 P_2}{\partial Q_2^2} Q_2 + 2\frac{\partial P_2}{\partial Q_2}} \tag{23}$$

The sign of (23) is negative implying that any increase in the flight volume by airline 1 leads to a reduction of flights for carrier 2. In order to determine the lower bound of the offsetting behaviour, the second order derivatives in (23) are set to be zero as implied in assumptions earlier. The extent of the compensation is then at least going to take the following form:

$$\frac{\partial Q_2}{\partial Q_1} = -\frac{M' + \frac{\partial P_2}{\partial Q_1}}{2M' + 2\frac{\partial P_2}{\partial Q_2}} \tag{24}$$

Now the question arises which dimensions $\frac{\partial P_2}{\partial Q_2}$ and $\frac{\partial P_2}{\partial Q_1}$ have. The first term is more comprehensible as it denotes the change in the airport charge of carrier 2 when altering the flight volume of carrier 2. The second, though, indicates the change in the landing fee of carrier 2 when airline 1 chooses to shift its number of flights. Both are positive but while the airport does indeed consider the flight volume of airline 1 when negotiating with carrier 2, the number of flights conducted by carrier 2 will likely play a greater role than the flight volume of its competitor. Though the difference will possibly be relatively small, the following will nevertheless apply:

$$\frac{\partial P_2}{\partial Q_2} > \frac{\partial P_2}{\partial Q_1} \tag{25}$$

The denominator in (24) will thereby be more than twice as large as the numerator. Carrier 2 will then offset any alteration in the flight volume of airline 1 by less than 50% at its minimum and by less than 100% at its maximum where the second order derivatives in (23) are positive and nonzero.

Airline 1 anticipates the offsetting attitude of carrier 2 and will account for it in its own profit calculations as shown below.

$$\pi_1 = \varphi s Q_1 - M[Q_1 + Q_2(Q_1)]Q_1 - \tau s Q_1 - P_1[Q_1, Q_2(Q_1), K]Q_1$$

The above is differentiated with respect to Q_1.

$$\frac{\partial \pi_1}{\partial Q_1} = \varphi s - M'\left[1 + \frac{\partial Q_2}{\partial Q_1}\right]Q_1 - M(.) - \tau s - \left[\frac{\partial P_1}{\partial Q_1} + \frac{\partial P_1}{\partial Q_1}\frac{\partial Q_2}{\partial Q_1}\right]Q_1 - P_1(.) = 0 \tag{26}$$

Comparing the first order condition (26) with the outcome of the Cournot duopoly (16) airline 1 will internalise even less congestion cost and likewise consider even less what impact its output decision has on airport charges. The extent is determined by $\frac{\partial Q_2}{\partial Q_1}$. The terms which used to restrict the flight volume of airline 1 in the Cournot case are weakened by the offsetting term of carrier 2 as shown below. The right hand side shows the related term in the Cournot case and the left hand side the corresponding term in the Stackelberg case.

$$M'\left[1 + \frac{\partial Q_2}{\partial Q_1}\right]Q_1 < M'Q_1$$

$$\left[\frac{\partial P_1}{\partial Q_1} + \frac{\partial P_1}{\partial Q_1}\frac{\partial Q_2}{\partial Q_1}\right] Q_1 < \frac{\partial P_1}{\partial Q_1} Q_1$$

As already stated $\frac{\partial Q_2}{\partial Q_1}$ is negative and the terms on the left hand side are therefore reduced by less than 50% at the least and less than 100% at the most in comparison to the right hand side. The outcome complies with the intuition that airline 1 will have less incentives to internalise congestion cost and likewise have less interest in keeping landing fees low by restricting its own flight volume as carrier 2 will always offset every attempt made by airline 1 to do so. Monopsony power then seems to decline to some extent as the key factor in utilising market power, the total flight volume, is not controlled by one airline any more. Any change by one airline will always be offset to some extent, but not entirely by the other which will have an impact on the negotiations to determine the landing fee.

The airport is neutral concerning the leader/follower constellation. Which airline operated during the previous season and which enters the market in the current season does not affect its profit calculation.

$$\pi_{AP} = P_1(Q_1, Q_2, K)Q_1 + P_2(Q_1, Q_2, K)Q_2 + (Q_1 + Q_2)\big[uX(u) - c\big(X(u)\big)\big] \\ -Kr - C(Q_1 + Q_2) \tag{27}$$

The two flight volumes Q_1 and Q_2 jointly make up the total flight volume Q. This fact is used when differentiating with respect to the concession prices and the capacity. In case of the concession services and the capacity the airport will not distinguish whether the customers shopping in the transfer area are flying with airline 1 or carrier 2 since this model assumes an equal behaviour of both customer groups. The average demand for concession services per flight is identical for both airlines. The same applies to capacity, since both airlines operate with the same aircraft type and the same seating capacity in the model by BRUECKNER & VAN DENDER (2008). Therefore the airport will only consider the total number of flights when deciding on its capacity. Concerning the landing fee, however, the airport does indeed differentiate between the two flight volumes as in a classic Stackelberg case, the two outputs are different. Unequal flight volumes will inevitably influence negotiations on landing fees and they will likely grant an advantage for the customer with the higher output, namely airline 1. The above factors influence the airport´s pricing behaviour yielding a different profit function than in the Cournot case (18).

$$\pi_{AP} = P_1(Q_1, Q_2, K)Q_1 + P_2(Q_1, Q_2, K)Q_2 + (Q)\big[uX(u) - c\big(X(u)\big)\big] - Kr - C(Q)$$

Differentiating with respect to the flight volume of airline 1, the price for concession services and the capacity derives the following three conditions:

$$\frac{\partial \pi_{AP}}{\partial Q_1} = \frac{\partial P_1}{\partial Q_1} Q_1 + P_1(.) + \frac{\partial P_2}{\partial Q_1} Q_2 + R - C' = 0$$

$$\frac{\partial \pi_{AP}}{\partial u} = QuX' + QX - Qc'X' = 0$$

$$\frac{\partial \pi_{AP}}{\partial K} = \frac{\partial P}{\partial K} Q - r = 0$$

The prices for aeronautical services and concession services as well as the capacity decision then are given by the following equations:

$$P_{1_{Stackelberg}}(.) = C' - R - \frac{\partial P_1}{\partial Q_1} Q_1 - \frac{\partial P_2}{\partial Q_1} Q_2 \quad (28)$$

$$u_{Stackelberg} = c' + \left(\frac{X}{-X'}\right)$$

$$r_{Stackelberg} = \frac{\partial P}{\partial K} Q$$

The subscript *Stackelberg* indicates that the above pricing principles are derived from an airport which serves two airlines competing in Stackelberg fashion and the subscript 1 marks the landing fee to be the one for airline 1. Carrier 2 follows an analogous condition.

While the price for concession services and the capacity decision remain unchanged compared to the monopsony and the Cournot case the landing fee (28) bears two alleviating terms instead of one. The discount granted to airline 1 does not only concern its own flight volume and landing fee but the one of the competitor as well. Next to the alleviation of the price conditional to its own flight volume, the airport rewards airline 1 for its effect on the landing fee of carrier 2. As the airport charge increases with the number of flights, an increase in Q_1 would not only increase the price for aeronautical services for airline 1 but also the one for carrier 2. This correlation leads the airport to grant this discount as well and therefore gives an incentive to increase the number of flights.

Assuming the airport is aware of the compensating behaviour between the airlines it will probably reduce the extent of the discount even further. As any alteration in the flight volume by one airline is offset by less than 50% at the least and less than 100% at the most by the other carrier the airlines will lose negotiating power. Their possibilities to influence the level of the airport charge through their output decisions seem to be limited even further. In the Cournot case the market power of the two airlines was believed to be smaller than in the standard monopsony case due to the increased output. In the Stackelberg case - next to the higher output than in the pure monopsony case - the offsetting behaviour is assumed to be known to the airport and likely strips the airlines of their negotiating power even further.

Then again, airline 1 might try to signal carrier 2 to cooperate with it through quantity leadership. Similar to price leadership where one company announces a rise in its prices and hopes the other companies will follow accordingly, airline 1 would announce a reduction in its flight volume and hope that carrier 2 would understand the invitation to jointly exert bying power through lower output. Whether carrier 2 will lower its flight volume as well would vary from case to case. If lower expenditures due to lower landing fees generate higher profits than increased ticket sales, due to the offsetting behaviour described above and an appropriately increasing market share, carrier 2 will act in a similar fashion to airline 1. If the opposite applies, carrier 2 will not participate in the attempt of airline 1.

A third possible outcome is airline 1 negotiating a long term contract with the airport in order to protect its benefits even if another carrier enters the market at the given airport. In such a case airline 1 will have to consider whether the obligations from a long term contract are too risky or whether the price stability alleviates that threat.

3.4 STACKELBERG OLIGOPOLY WITH A COMPETITIVE FRINGE

Finally, the above Stackelberg case is altered to accommodate more than only two airlines. Similar to the original model by BRUECKNER & VAN DENDER (2008) airline 1 remains the Stackelberg leader but carrier 2 is now considered to act competitively. This appears to be plausible if carrier 2 is considered to be a group of many airlines operating to and from the given airport. The flight volume at the given airport of each of the airlines in carrier-group 2 is very small. The airline companies themselves operating the flights, however, need not be small in size. Only their share of the total number of flights at the discussed airport remains very limited. Thus, a fringe airline of carrier-group 2 could be a small charter airline, a large flag carrier that operates only few flights to and from the hub of airline 1 or anything between those two.

Due to the atomistic behaviour and the small flight volume of each airline in carrier-group 2, none of them can negotiate with the airport on landing fees and therefore consider the airport charge to be parametric. The delay costs are also seen as parametric since no airline in carrier-group 2 can influence the level of congestion. The profit function then takes the following form:

$$\pi_2 = \varphi s Q_2 - M Q_2 - \tau s Q_2 - P_2 Q_2$$

$$\pi_2 = [\varphi s - M - \tau s - P_2] Q_2$$

Considering the landing fee P_2 and the delay cost due to congestion M as parametric, the above profit function for each of the airlines in carrier-group 2 is proportional to Q_2 with the proportionality factor equal to $\varphi s - M - \tau s - P_2$. The proportionality factor must satisfy the following condition:

$$\varphi s - M - \tau s - P_2 = 0$$

A positive proportionality factor would imply infinite profits if the carrier increased its number of flights infinitely. A negative factor would then in contrast generate losses for carrier 2 independent from the flight volume which would lead carrier 2 to stop flying to the airport in question. Therefore, the proportionality factor must be zero which implies zero profits for each airline in carrier-group 2.

Although the landing fee P_2 is considered to be parametric by each airline of carrier group 2, the airport charge is still determined by the flight volume Q_2. Single airline activity within carrier 2 cannot have an impact on the level of congestion or the landing fee but the collective behaviour of the airlines does indeed have one. The price for aeronautical services and the cost of delay are then no longer parametric. The proportionality factor can then be totally differentiated in order to obtain a behavioural pattern how carrier 2 should react to changes in the flight volume of airline 1.

$$\frac{\partial Q_2}{\partial Q_1} = -\frac{M' + \frac{\partial P_2}{\partial Q_1}}{M' + \frac{\partial P_2}{\partial Q_2}} \tag{29}$$

Bearing in mind that its own output has a stronger impact on its own landing fee than the output of the competitor as stated in the previous chapter (25), the denominator in the above fraction (29) is then only slightly greater than the numerator. This implies that any shift in the flight volume by airline 1 is nearly completely offset by the airlines within carrier 2. Due to this behaviour airline 1 has no substantial possibility to exert any kind of bying power as any attempt to do so in terms of decreasing the number of flights is countervailed by carrier 2. This is probably going to remove any remaining incentive to restrain the flight volume on the part of airline 1 and forces it to behave in an atomistic manner as well. The diminishing interest of airline 1 to control its flight volume can be shown in its profit calculation.

$$\pi_1 = \varphi s Q_1 - M[Q_1 + Q_2(Q_1)]Q_1 - \tau s Q_1 - P_1[Q_1, Q_2(Q_1), K]Q_1$$

Differentiating the above profit function with respect to the flight volume Q_1 yields the following condition:

$$\frac{\partial \pi_1}{\partial Q_1} = \varphi s - M'\left[1 + \frac{\partial Q_2}{\partial Q_1}\right]Q_1 - M(.) - \tau s - \left[\frac{\partial P_1}{\partial Q_1} + \frac{\partial P_1}{\partial Q_1}\frac{\partial Q_2}{\partial Q_1}\right]Q_1 - P_1(.) = 0$$

Both terms, which used to restrict the flight volume of airline 1 in the Cournot case (16) will now almost completely disappear. Bearing in mind that $\frac{\partial Q_2}{\partial Q_1}$ is in fact nearly -1 the two terms in the square brackets are close to zero and will therefore alleviate the incentive to restrict the flight volume by airline 1 accordingly.

The airport, however, is not going to change its approach from the previous subsection. It is neutral concerning the leader/follower constellation. The profit function will still be (27).

$$\pi_{AP} = P_1(Q_1, Q_2, K)Q_1 + P_2(Q_1, Q_2, K)Q_2 + (Q_1 + Q_2)\big[uX(u) - c\big(X(u)\big)\big]$$
$$-Kr - C(Q_1 + Q_2)$$

The airport will again only distinguish between the two flight volumes in the case of the price for aeronautical services as discussed earlier. When determining the price for concession services and the capacity it considers the total flight volume $Q = Q_1 + Q_2$. The profit function is differentiated with respect to the output of airline 1, the price for concession services and the cost of capital and naturally the first order conditions resemble the ones in the previous subsection.

$$\frac{\partial \pi_{AP}}{\partial Q_1} = \frac{\partial P_1}{\partial Q_1} Q_1 + P_1(.) + \frac{\partial P_2}{\partial Q_1} Q_2 + R - C' = 0$$

$$\frac{\partial \pi_{AP}}{\partial u} = QuX' + QX - Qc'X' = 0$$

$$\frac{\partial \pi_{AP}}{\partial K} = \frac{\partial P}{\partial K} Q - r = 0$$

The price for concession services and the capacity decision of the airport will not change in spite of the different market situation.

$$u_{atomistic} = c' + \left(\frac{X}{-X'}\right)$$

$$r_{atomistic} = \frac{\partial P}{\partial K} Q$$

The subscript *atomistic* denotes that these pricing principles are derived from the case where the airlines behave in atomistic manner. The airport still sets the prices for concession operations at the profit maximising level and the capacity should still reach the level where the cost of capital is equal to the additional revenue gained from the last expansion in capacity.

The price for aeronautical services also is the same as in the standard Stackelberg case. As both airline 1 and carrier 2 act equally, both will pay an airport charge according to the pricing principle below.

$$P_{1_{atomistic}}(.) = C' - R - \frac{\partial P_1}{\partial Q_1} Q_1 - \frac{\partial P_2}{\partial Q_1} Q_2$$

The landing fee, however, will probably be higher for both than in the standard Stackelberg case. On the one hand the number of flights is going to be higher as both disregard their output´s influence on congestion and prices for aeronautical services. On the other hand due to the atomistic and the almost fully offsetting behaviour the airport may not grant any or only a very limited discount. If any variation in the flight volume of one airline will be compensated nearly entirely by the other(s), then the influence the shift previously had on the prices is going to be zero or very close to that. In the extreme case of the discount being zero, the following is going to apply:

$$\frac{\partial P_1}{\partial Q_1}, \frac{\partial P_2}{\partial Q_1} = 0$$

Regardless of the airline company the landing fee would then take the form of:

$$P_{atomistic}(.) = C' - R$$

No monopsony power can be exerted as the main tool - the output - is not controllable by any airline operating to and from the given airport.

This model then shows that the landing fee seems to rise when the number of airline companies flying to and from the airport in question increases. This, however, strongly depends on the market constellation. In BASSO & ZHANG (2007) the authors set up a model with two airports competing with each other over the same airlines and passengers meaning the airlines could consider an outside option. They find that the entry of a new airline to any of the two airports pushes the landing fee down at both of them. In contrast to this paper, however, the number of airlines in BASSO & ZHANG (2007) is set to be exogenous and the carriers are not considered to have any monopsony power. In the case of maximising social welfare, however, a markdown term in the landing fee is present in order to subsidise the monopolistic or oligopolistic airline companies and to countervail thereby the exploitation of their market power. With an atomistic structure the markdown term becomes zero. The outcome in the social optimum in BASSO & ZHANG (2007) are similar to the one presented in this paper. The motive behind the markdown term, however, differs considerably. In this paper the airport is compelled to enter into negotiations to lower the landing fee due to the airlines´ monopsony power whereas the partly similar outcome in BASSO & ZHANG (2007) originates from the central planners aim to maximise social welfare.

Although monopsony power in the fourth case seems decrease significantly, some market power might still be left due to other circumstances. Regardless of the its atomistic behaviour airline 1 still operates most of the flights as in this model it is assumed that according to a standard Stackelberg case the output of the leader is greater than the one of the follower. This constellation would allow the assumption that the airport in question is the hub airport for airline 1. This airport then serves the passengers of airline 1 as one or the main transfer point from one flight to the other. Previously the per flight demand for concession services was considered to be equal for all flights regardless of the airline company. This assumption might be thwarted by figures presented by GRAHAM (2009, P. 107), where the share of commercial revenues in total revenue is over 50% at airports with a high number of transfer passengers such as London Heathrow. At airports not serving as a transfer hub (such as Salzburg) the share is hardly over 20%. This implies that transfer passengers spend much more for commercial services than passengers who start or finish their journey at the airport in question. This would again imply that some negotiating power might be left on part of the home carrier. Examining official terms and conditions of airports suggest that such correlations are indeed considered. According to FINAVIA (2012, P. 14) airlines do not have to pay charges for passengers who transfer from domestic flights to international flights and vice verca at Helsinki airport. The main profiteer is the Finnish flag carrier Finnair and its partner for domestic flights Flybe. Discounts for transfer passengers are, however, comprehensible owing to the passengers not having to go through baggage claim and check in procedures and therefore causing less expenses for the airport.

A similar condition can be found in Vienna in the terms and conditions of FLUGHAFEN WIEN AG, (2012, P. 7). If the airline operates many flights to and from Eastern Europe the airport grants a discount of up to 40%. In addition, flights to long haul destinations pay up to 50% less according to the frequency. Both discounts are especially advantegous for Austrian Airlines, whose target markets are the long haul services from and to Vienna as well the Eastern European market.

Hence, inspite of losing monopsony power the home carrier might after all retain some market power even if it is by far not the only one operating at the given airport. Market power due to home carrier status is, however, not described in this model but seem to be worthwile studying. Next to discounts based on transfer passengers and destination choices the position of a home carrier might emerge advantegous in questions of gate vs. ground arrivals, dedicated terminals and check-in facilities, grandfather-rights to slots and long term contracts with the airport.

4 Effects of Common Forms of Airport Regulation

In this section the effects imposed by common forms of airport regulation on an airport serving one airline are considered. Again, the approach is generally equal to the one discussed in OUM ET AL. (2004). The authors, however, consider the airport to have market power. Therefore, after reviewing briefly the effects of regulation on an airport with market power, the regulatory effects on an airport without market power are discussed. Market power shifts from the airport to the airline flying to and from the airport in question as discussed in sectioon 3.1. Rate-of-return or RoR regulation is discussed first followed by the consideration of a price-cap regulation.

4.1 RATE-OF-RETURN REGULATION

Under single-till rate-of-return regulation the airport with market power is pushed to set its landing fee at a level where costs from both aeronautical and concession operations are covered including return on invested capital. The regulator sets an allowed rate of return s and the airport should then set its airport charges in order to satisfy the following condition:

$$P(Q,K)Q - C(Q) + QR = Ks$$

The aim of the airport is still to maximise profits but it has to operate under the above restriction.

$$\max_{P,u,K} P(Q,K)Q - C(Q) - Kr + QR$$

$$s.t. P(Q,K)Q - C(Q) + QR = Ks$$

The issues connected with RoR regulation are generally well known and do not remain unmentioned in OUM ET AL. (2004). The first difficulties already appear when the regulator should define what to determine as capacity K and particularly the current value of the used capital. Whether regulation is based on the market value or the acquisition cost less depreciation, will yield different basic figures. Second, assessing the level of the allowed rate of return s is ultimately a decision made by authorities or politicians and therefore bears the corresponding challenges. Third, the regulator has to determine quite precisely which expenditures can be detracted from the profits and which cannot. If for instance expenses for advertising would be allowable, the airport could then start a campaign against regulation and use the generated cost to declare it has higher expenditures and could then set higher prices for aeronautical services. Fourth, in the event of the allowed rate of return s being greater or equal to the actual cost of capital r, the airport would have an incentive to oversize its investments in capital which leads to a productive inefficiency, i.e. "gold plating". This overinvestment is commonly referred to as the A-J effect or A-J distortion referring to the authors of AVERCH & JOHNSON (1962). The RoR regulation in essence is then cost-based and a regulated airport with market power would not gain anything from cost reductions. Any incentive to improve productive efficiency is therefore lost.

The above mentioned issues, however, might not apply to an airport without market power serving only one airline with monopsony power. The difficulties in determining K and s remain regardless of any market situation, but the A-J distortion and the problems related to the question which expenses can be detracted from the profits seem to be alleviated. Since an airport serving one monopsonistic airline has an incentive to keep the landing fee as low as possible, it will most likely ensure as efficient services as possible and will not allow any unnesessary expenses as for counter-regulation campaigns to occur. Further, the authors OUM ET AL. (2004, p. 228) highlight, that the Averch-Johnson effect is only present if the allowed rate of return is greater or equal to the actual cost of capital. The given airport discussed in this paper, however, has an incentive to keep the landing fee as low as possible due to the market situation. It will most likely not make excessive investments in capital since it would only push the price for aeronatical services which would be counterproductive.

The resembleance of RoR regulation to the discussed market situation seem to be notably present when considering dual-till RoR regulation which applies only to the aeronautical sector whereas the concession services remain unregulated. Therefore the regulatory constraint takes the following form:

$$P(Q,K)Q - C(Q) = Ks$$

In OUM ET AL. (2004) the authors suppose that the allowed rate of return s is set to be equal to the actual cost of capital r. The airport then aims to fulfill the following:

$$\max_{P,u,K} Q\left[uX(u) - c\big(X(u)\big)\right]$$

$$s.t. P(Q,K)Q - C(Q) = Kr$$

The concession services are not a part of the restriction anymore, on the contrary, the airport sets to maximise its profits in the concessions sector. The airport will therefore look into ways to maximise the flight volume as more flights deliver more customers for concession services. The only way the airport can influence the flight volume is by adjusting the landing fee. It will then keep the price for aeronautical services as low as possible and set monopolistic prices in concession services.

This behaviour out of RoR regulation seems to coincide with the behaviour of an airport with only one airline as a customer. Using its monopsony power the airline forces the airport to keep the airport charge as low as possible. The airport, meanwhile, sets monopolistic prices for concession services in order to maximise profits generated by those services. The profits are then used to lower the landing fee further. The resemblance between the dual-till RoR regulation and the first monopsony case discussed in this paper can be shown if the above objective from a regulated airport is further assessed.

$$L = Q[uX - c(X)] - \mu[P(Q,K)Q - C(Q) - Kr]$$

Differentiating the Lagrangean function with respect to the flight volume, price for concession services and capacity yield the following first order conditions:

$$\frac{\partial L}{\partial Q} = [uX - c(X)] - \mu\left[\frac{\partial P}{\partial Q}Q + P(.) - C'\right] = 0$$

$$\frac{\partial L}{\partial u} = QuX' + QX - Qc'X' = 0$$

$$\frac{\partial L}{\partial K} = -\mu\frac{\partial P}{\partial K}Q + \mu r = 0$$

which lead to the corresponding pricing principles:

$$P_{RoR}(.) = C' + \frac{R}{\mu} - \frac{\partial P}{\partial Q}Q \qquad (30)$$

$$u_{RoR} = c' + \left(\frac{X}{-X'}\right) \qquad (31)$$

$$r_{RoR} = \frac{\partial P}{\partial K}Q \qquad (32)$$

The subscript *RoR* is to identify the pricing principle to be the one of an airport under rate-of-return regulation.

Both the price for concession services (31) and the capacity choice (32) are equal to the ones an airport would set or choose respectively if serving only one airline with market power, (12) and (13) respectively. The airport charge (30), however, includes the Lagrangean multiplier μ. Should the multiplier or the shadow price of the restriction be *-1*, the landing fee (30) would be identical with monopsony result (11).

While the RoR regulation is cost based and a regulated airport would lose incentives to improve productive efficiency, monopsony power on the part of the airline would alleviate the distortion brought upon the regulation. In order to save the cost of regulation, it therefore would seem to be necessary to re-evaluate the necessity of RoR regulation on an airport which serves only one airline. It is, however, important to note, that monopsony power does not generate a socially efficient outcome. The flight volume and the airport charge for aeronautical services seem to be inefficiently low. The extent of the ineffiency depends primarily on the elasticity of supply of the airport. In order to alleviate the inefficiency, RoR regulation does not seem to be suitable.

4.2 PRICE-CAP REGULATION

The second form of regulation discussed in OUM ET AL. (2004) is the price cap. The regulator sets a specified price cap P^* which cannot be exceeded by the airport. The price cap is not static as it will be adjusted periodically depending on retail price index and how the airport is expected to improve efficiency in the forthcoming period. The regulator sets the price cap in light of the previously mentioned factors so that the expected profits would yield a fair rate of return on invested capital. Should the airport be able to outperform the expected efficiency level, then it will be able to keep any gains out of it which ensures the incentive for the airport to improve productive efficiency.

Under single-till price-cap regulation the pricing principle for aeronatical services then follows the rule:

$$P_{PC} = E\left\{\frac{C(Q) + Kr}{Q}\right\} - R$$

where subscript PC indicates price-cap regulation.

Under single-till regulation total revenues airport including both aeronatical and concession services is expected to reach break-even. The incentive to improve efficiency, however, is preserved as the airport is allowed to keep any extra profits due to increased efficiency. Further, the landing fee is reduced by the concession profits meaning the airlines are charged below cost. This seems like a cross-subsidy from the viewpoint of airport operations. In OUM ET AL. (2004) the authors, however, point out that the concession services are mainly extracted from passengers meaning the cross-subsidy is rather a transfer from passengers to airlines. One of the assumptions in OUM ET AL. (2004) is that airlines will adjust airline fares accordingly to changes of landing fees. Therefore the transfer will not have negative welfare impact.

The dual-till price-cap regulation considers only the aeronautical services. Hence the pricing principle for the landing fee then reduces to:

$$P_{PC} = E\left\{\frac{C(Q) + Kr}{Q}\right\}$$

The profits from concession services are not used to lower the landing fee. The airport charge under dual till is then higher than under single-till regulation. The extent of the increase is the amount of the concession profits resulting in a less restrictive price cap. It is, however, important to stress the fact, that the airport still has an incentive to increase productive efficiency as it is allowed to keep any profits generated by higher efficiency.

The price-cap regulation, though, also has its weaknesses as shown in OUM ET AL. (2004). While the RoR regulation was found to lead airports to over-invest in capacity the price-cap regulation leads to underinvestment. In contrast to the welfare-maximising (3) and profit-maximising airport (7) capacity is not chosen at it efficient level as shown by the authors.

$$-Q\frac{\partial D}{\partial K} > r$$

The shadow value of capacity seems to be larger than the cost of capital which leads the authors to conclude that the airport under-invests in capacity. Investments into capacity, e.g. new parking positions for aircraft, will lower congestion. Passengers will have to bear lower delay cost and their willingness to pay for air travel will increase. The airport with market power would then increase its landing fee in order to skim the higher willingness to pay, internalising the benefit out of a higher capacity. If, however, the airport is price cap regulated, then it cannot raise prices for aeronautical services and therefore cannot fully exploit the benefit from the reduction in congestion. It has therefore less incentives to invest into capacity and will set a socially inefficient level of capacity.

As shown above, the price cap under single-till is lower than under dual-till due to the inclusion of the concession profits. The dual-till price cap is therefore less restrictive which allows the authors to draw the conclusion that the problem with under-investment is less pronounced under dual-till regulation. Still, any binding price cap is going to influence the airport´s capacity decision in a socially undesireable way.

Whether the price-cap regulation has an effect on an airport without market power and whether the given airport will under-invest into capacity is questionable. The aim of the price cap is to lower too high landing fees in order to increase the number of flights to a socially more efficient level. If, however, the airport serves one airline with monopsony power, the prices are most likely already low and the low flight volume originates from monopsony power on the part of the airline rather than from too high landing fees. The airport in question has already the incentive to keep the landing fee as low as possible due to the market situation. While the monopolistic airport under price-cap regulation is allowed to keep any extra profits from efficiency gains, the airport without market power will likely use those extra profits to lower the landing fee even further. In both cases the two kind of airports retain the incentive to explore any possible efficiency gains but out of a different motivation. The first one can keep the profits, the other will use it to lower the landing fee in order to attract more flights. If the price cap is binding, meaning the airport cannot go below the airport charge set by the regulator, then the airport without market power would still have an incentive to improve productive efficiency as it is able to keep the extra profits. Price-cap regulation then does not seem to have an effect on the behaviour of the airport in question if the airport is allowed to go below the set price cap. The flight volume, however, will still remain inefficiently low from a social viewpoint due to the monopsony power of the airline regardless of the regulatory framework.

The earlier discussed issue of under-investment due to regulation does not seem to affect an airport without market power. While capacity investments would typically lower delay cost due to congestion it should be questioned whether an airport which serves only one airline will even have to deal with congestion due to a high flight volume. The model by BRUECKNER & VAN DENDER (2008) can be altered to accomodate only one airline.

$$\pi_{AL} = \varphi s Q - M(Q)Q - \tau s Q - P(Q,K)Q$$

The subscript *AL* is to differentiate the above profit function from the airport´s profit function. Differentiating the above with respect to the flight volume Q yields the following first order condition:

$$\frac{\partial \pi_{AL}}{\partial Q} = \varphi s - [M'Q + M(.)] - \tau s - [P'Q + P(.)]$$

As expected, the airline seems to internalise the delay cost due to congestion. The flight volume on the given airport will therefore likely remain below the capacity limit. Furthermore, a highly congested airport which is only serving one airline appears to be unrealistic as a highly frequented market will probably attract other airline companies as well. When only one airline flies to and from the given airport, the investments on the part of the airport will then likely be limited to increase productive efficiency as it does not seem to need to increase capacity.

Consequently, an airport without market power under price-cap regulation does not seem to have a reason to change its pricing principles and capacity decision compared to the unregulated case. The entry of additional airlines into the market, however, will possibly change this outcome as monopsony power on the part of the first airline gradually decreases depending on the market structure and number of competitors as described in section 3.

Regulators then need to be well aware of the market situation at the airport in question. Next to the market situation at the given airport, however, the market situation at the destination could also influence the airline´s output decision. Supposedly the airline plans to fly to ten destinations from the airport in question. Next to evaluating the market situation at the home base the airline has to consider the market situation or slot availability at each of the ten destinations. High level of congestion, market saturation or even monopsony power at the other airports might influence the airline´s output decision and distort the behaviour described in this model.

5 Conclusion

This paper studied the pricing principles and capacity decisions generated at an airport where market power has shifted from the airport to the airlines. Consequently, and in contrast to current research, airlines were given the power to compel the airport to enter into negotiations concerning the prices for aeronautical services. The airport’s pricing principles were found to change according to the market situation.

As shown in OUM ET AL. (2004) a profit maximising airport with monopoly power will set higher prices than socially desirable according to the elasticity of demand for air travel. Altering the given model by OUM ET AL. (2004) to accommodate monopsony power on the part of the airlines shows how the airport adjusts its behaviour according to the market situation. If only one airline operates the airport, it is granted a discount according to the airport´s elasticity of supply and the airline will exert its monopsony power by operating a correspondingly low number of flights. Monopsony power will weaken as soon as other airline companies start to fly to and from the airport in question. In symmetric Cournot competition the calculative discount is cut by half and the flight volume rises. In case of Stackelberg competition, the leader will offer more flights than the follower. The follower, however, will offset any change in the leader´s flight volume by less than 50% at the least and below 100% at the most. This limits airline buying power further.

The remaining market power on part of the airlines seems to fade if the number of airlines is increased further. Considering the Stackelberg follower as a group of airlines will force this group to view the landing fee as parametric as the fragmented market structure does not allow them to bargain on the landing fee. Furthermore, any alteration of the leader’s flight volume will be compensated by the follower by nearly 100%. This behaviour on the part of the follower forces the leader to act similarly. To exercise monopsony power by adjusting the flight volume is then impossible as one airline will always offset the reduction of another one. The leader, however, still operates the majority of the flights. It can be considered to be the home carrier and therefore other means of influence to the airport charge are likely.

Common regulatory options were also studied in this paper. The rate-of-return regulation and price-cap regulation in both single-till and dual-till layouts were reviewed and their impact on the pricing principles of the airport was considered. Both forms of regulation are geared towards lowering too high prices set by monopolistic airports. An airport with no market power serving a monopsonistic airline, however, has no incentive to set too high prices. Due to the airline´s monopsony power the airport will use any efficiency gains to lower the landing fee even further in order to attract more flights. With decreasing monopsony power this incentive might be weakened. Regulators then should examine carefully whether any form of regulation is needed as potentially non-essential regulation would burden society. The slightest alteration in the structure of the market, however, might possibly necessitate the introduction of regulatory undertakings. Another factor to influence the airline´s output decision could be the market situation or the availability of slots at the destinations operated from the given airport. Considering this, dual approach might result in an interesting area for future research.

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