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A NOTE ON "PRICE CAP REGULATION OF CONGESTED AIRPORTS"

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A Note on "Price Cap Regulation of Congested Airports"

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Abstract

Conventional economic models in airport regulation assume, that airports have considerable market power and may exploit it against airlines. Given, that many airports are served by only a limited number of airlines, mono- or oligopsony relationships may exist. This paper relaxes therefore this assumption. We use an existing model to test the impact of mono- and duopsony on the outcome of several regulatory options. Our results show, that in such cases the binding conditions for airport charges may change and, hence, optimal airport regulation should take into account also the degree of mono- or oligopsony airline power. In some cases the abolishment of any kind of regulation can lead to welfare gains.

Keywords: Airport Regulation; Single-Till; Dual-Till; Airline Monopsony and Oligopsony Power

JEL Classification: L 51, L 93, R 41.

1 Introduction

Airport regulation is an extensively analyzed topic in literature. In general, models of airport regulation assume that airports have considerable market power against airlines and that they may exploit this. A regulatory rule is therefore needed (e.g. price cap or cost based regulation) in order to enhance social welfare. In this respect the role of concession services is highlighted as well. Regulatory options such as single-till and dual-till regulation are for this reason intensively discussed. Their superiority is mainly linked to the degree of congestion at the airport in question.[1]

It is not the scope of this paper to provide another model in airport regulation. Much more we use an existing modeling framework provided by Yang and Zhang (2011) in order to relax one important assumption, notably the one of airport market power. Real world observations reveal that various international and regional airports around the world are mainly served by one or two major airlines with a competitive fringe. For instance Delta Airlines operates more than 70 percent of flights at Atlanta´s Hartsfield-Jackson International Airport. Another example is Frankfurt Airport, Germany, where Lufthansa holds a market share of around 60 percent . The second largest airline, British Airways has a market share of hardly four percent (Button 2010). It is therefore natural to assume, that due to its market share the dominating airline has strong bargaining power against the airport when it comes to user charges. This countervailing power to the airport monopoly enables the airline to influence the price and, in this way, may restrain the airport from exploiting its market power. From this point of view airport regulation models should incorporate monopsony -or oligopsony- relationships between the airport and the airlines.

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[1] A recent overview on the existing literature on airport regulation may be found in Zhang and Czerny (2012).

However, assuming airline bargaining power, translates into two major limitations for the modeling exercise provided in this paper. First, in the case of bilateral monopoly (where one airline and one airport negotiate airprort charges) it is well known (Myerson and Satterthwaite 1983), that no efficient bargaining equilibrium can be reached, if both sides do not have an outside option. This seems to apply also in many cases in air transport. A possible threat of an airline to switch its hub airport lacks credibility. Likewise, it can be observed that several hub airports provide significant discounts to their home carriers. In the case of hub airports an outside option seems not to hold for both of the contract partners. This, however, may change in the case of regional airports. Low-cost airlines can relatively quickly switch between different airports and use this flexibility when negotiating airport charges. Second, if an airport has two possible airlines as users it could play them off against each other by offering exclusive contracts and therefore achieve the same result as in the monopoly case (Hart and Tirole 1990). Keeping both described limitations in mind, we assume on the one hand, that airlines always have an outside option when bargaining with airports and on the other hand, the airport is not willing to offer exclusive contracts to airlines. That is, we model the lowest level of airport charges knowing that in reality it is possibly higher.

The remainder of the paper concentrates on the modeling framework. The elements of mathematical formulation, based in the model provided by Yang and Zhang (2011), are presented in section 2. Section 3 deals with the case of monopsony. Section 4 extends the modeling framework to the duopsony case, where airlines compete in a Cournot fashion. Finally section 5 concludes.

2 The Model by Yang and Zhang (2011)

Yang and Zhang (2011) analyze the single-till and dual-till price-cap regulation with respect to optimal welfare. In contrast to Czerny (2006) they consider price-cap regulation of a congested airport where the airlines possess market power. It is clear why a congested airport is analyzed as most airports have scarce runway and terminal capacity, so that traveling leads to delays $D(\tilde{Q}, K)$[2] due to congestion. Congestion raises costs of both passengers and airlines. Hence, two types of cost from airport congestion can be identified. First, delays increase individual travel time valued with α per unit of time and second, delays affect airline operating costs which increase with β per delayed unit of time. Further, many airports are dominated by one or two airlines only. Therefore, it would not be suitable to use an atomistic model in an airport context (Brueckner 2002). Due to oligopolistic market structure airlines may have significant market power. However, the latter describes the situation on the output market, i.e. the market between airlines and passengers. According to Yang and Zhang (2011) carriers do not have market power in the input market. For aeronautical services the airport is a monopolistic supplier and can exploit its market power. Therefore, regulation is necessary. The main object of Yang and Zhang's analytical approach is to identify whether single-till or dual-till regulation performs better at a congested airport in terms of optimal welfare. Similar to Czerny (2006) they find that single-till regulation performs better than dual-till regulation when there is no significant airport congestion. Additionally, they show that dual-till regulation dominates single-till regulation when airport congestion reaches very high levels. In order to model the airport operator's behavior the passengers' demand for air travel and concession services needs to be determined. The former equates to the passengers' perceived full price of an airline, which is the sum of airline fare and the congestion costs. The latter is different to previous approaches. Demand for concession services is not a fixed proportion of the aeronautical demand where the price for concession services is exogenously given but it is given by a distribution and density function of the passengers' valuation of commercial services. In addition, passengers do not decide on flying and buying concessions simultaneously but rather sequentially. Furthermore, in contrast to Czerny (2010) only passengers can decide to purchase commercial services.

[2] Note that the delay function $D(\tilde{Q}, K)$ is a function of total demand $\tilde{Q}$ and airport capacity K.

The airport regulation itself can be described as a three-stage game. First the regulator determines the price-cap under the cost recovery constraint, then the airport chooses the charges on aeronautical and concession services and finally the airlines decide on their profit maximizing output. The solution of this game identifies the relevant aeronautical charges under single-till and dual-till regulation and the airport's profit-maximizing aeronautical charge p_a^π , which is independent of the value of time υ, where υ denotes the composite (airline and passenger) per-passenger time valuation ($\upsilon = (\alpha + \beta)\theta$, θ denotes a positive scale parameter). Both price-caps (under single-till regulation p_a^s and under dual-till regulation p_a^d) are increasing and convex in υ. Furthermore, under single-till price-cap regulation p_a^s is binding for a profit-maximizing airport. In contrast, the dual-till price-cap will be binding as long as $p_a^d < p_a^\pi$, otherwise the airport will choose the profit-maximizing aeronautical charge. In comparison the aeronautical charge under single-till price-cap regulation is strictly lower than the one under dual-till regulation. The welfare-maximizing aeronautical charge p_a^e is increasing and concave in υ and is constantly lower than the profit-maximizing charge.

Yang and Zhang (2011) utilize these results to develope three scenarios. In scenario 1 the socially efficient aeronautical charge is always lower than the single-till and dual-till aeronautical charges. Hence, single-till regulation dominates dual-till regulation regardless of the level υ and therefore independently of airport congestion. In the second scenario the efficient aeronautical charge curve intersects with both, single-till and dual-till charges. If υ is sufficiently low or high again single-till regulation dominates dual-till regulation. For intermediate levels of υ dual-till regulation outperforms single-till regulation under the condition that the efficient aeronautical charge covers airport cost associated with aeronautical services. Otherwise regulatory performance depends on whether the socially efficient aeronautical charge exceeds or falls below the average of single-till and dual-till charges. In scenario 3 the socially efficient aeronautical charge curve intersects only with the single-till regulation price-cap curve. The results here are very similar with those of scenario 2.

To sum up Yang and Zhang (2011) show that dual-till regulation is dominated by single-till regulation if the value of time is sufficiently low or high. Therefore, single-till regulation performs better, if airport congestion is not a major problem. In addition, they draw cases in which dual-till regulation performs better. Hence, if congestion is a major problem at the airport, dual-till regulation could dominate single-till regulation.

3 The Monopsony Case

As already mentioned, various international and regional airports are dominated by a single airline. In the following we consider a single seller i.e. the monopolistic airport and the countervailing power of a single buyer i.e. the monopsonistic airline. For simplicity we assume that the airport does not possess market power over the monopsonistic airline. Apart from the reason discussed in the introduction there are also additional arguments for this. First, some degree of airport competition seems to exist (see e.g. Starkie 2002),[3] particularly in the case with LCC at regional airports. Second, often vertical relationships between airports and airlines take place. In Munich, for instance, Lufthansa holds a 40 percent share of Terminal 2 and can exert significant influence over planning decisions (Fu et al. 2011). The same can be observed for Frankfurt airport, where Lufthansa currently owns about ten percent of shares of operator Fraport AG (Fraport 2012). Other cases can also be observed worldwide (CAPA 2010).

The main object of this section is to analyze to which extent the monopsonistic power influences the airport charges and the necessity of regulation in terms of optimal welfare. The setup of a monopsony is characterized by a single buyer (the price maker) and a variety of sellers or a single seller without market power (the price taker). The monopsonist not only obtains a price below the monopoly price but also a price below the competitive equilibrium.

[3] To our opinion the question of the underlying airport competition model has not been definately answered yet.

We adapt the model of Yang and Zhang (2011) so that only a single airline operates at the airport ($n = 1$). Additionally, the airline produces its output using a single input factor x according to the production function $q(x) = x$. The corresponding airline cost function changes under the assumption of a monopsony. It consists of the airline's unit operating costs c, the congestion costs $\beta D(\tilde{Q}, K)$ and the aeronautical charge p_a. The latter is no longer fixed but can be influenced by the airline. The airport's factor supply curve is assumed to be upward-sloping. That is, the more the airline wants to produce, the higher the factor price. The inverse supply function of the airport is assumed as follows:

$$p_a(x) = c_a + tx \; , \tag{1}$$

where c_a denotes the airport's operating cost per passenger and t is a positive parameter. Thus, the airline's cost curve becomes

$$C(x) = p_a(x)x + cq(x) + \beta D(\tilde{Q}, K)q(x) \; . \tag{2}$$

In addition, since $n = 1$ the delay function $D(\tilde{Q}, K) = \theta Q$ can be reduced to $D = \theta q(x)$. Given the production function $q(x) = x$ the resulting cost function takes the form

$$C(x) = c_a x + tx^2 + cx + \beta\theta x^2 \tag{3}$$

and thus the marginal cost function is given by

$$MC(x) = \frac{dC(x)}{dx} = c_a + 2tx + c + 2\beta\theta x \; . \tag{4}$$

In the next step we specify the airline's revenue function. Given the airline market power on the output market the demand function and the airline's fare depend on x. Therefore (because of $n = 1$) the demand function will be

$$\rho(x) = a - bq(x) \; , \tag{5}$$

so that the resulting ticket price is

$$p(x) = a - bq(x) - \alpha\theta q(x) \; . \tag{6}$$

Consequently the airline's revenue function has the form

$$\begin{aligned} R(x) &= p(x)q(x) \quad \text{with} \;\; q(x) = x \\ R(x) &= ax - bx^2 - \alpha\theta x^2 \end{aligned} \tag{7}$$

and thus marginal revenue is

$$MR(x) = a - 2bx - 2\alpha\theta x \; . \tag{8}$$

The airline's objective is profit maximization. Solving for $MR = MC$ yields

$$x^{ms}(\upsilon) = \frac{a - c - c_a}{2(t + b + \upsilon)} \; , \tag{9}$$

where superscript ms denotes the monopsony case. Therefore, the new aeronautical charge under monopsony takes the form of

$$p_a^{ms}(\upsilon) = c_a + t\frac{a - c - c_a}{2(t + b + \upsilon)} \; . \tag{10}$$

The first and second derivatives

$$\frac{dp_a^{ms}(v)}{dv} = -\frac{t(a-c-c_a)}{2(t+b+v)^2} < 0 \quad (11)$$

$$\frac{d^2 p_a^{ms}(v)}{d^2 v} = \frac{t(a-c-c_a)}{(b+t+v)^3} > 0 \quad (12)$$

show that the monopsony price is decreasing and convex in the value of time. That means the higher the airline's and passengers' total value of time the lower the price the carrier has to pay. Hence, at an airport with low levels of congestion the aeronautical charge will be lower than at an airport with higher levels of congestion. In turn, the airline will adjust its quantities of demand, fully internalizing its own effect on airport congestion since it is the only one operating in a monopsony (see e.g. Brueckner and van Dender 2008). If the value of time is sufficiently low, passengers and the airline do not care about congestion delays and behave as if there were no airport congestion. Demanded quantities increase so that the monopsony aeronautical charge is high too. If the value of time is sufficiently high passengers and the airline are very sensitive to congestion delays. Therefore, demand decreases and the airline offers a low aeronautical charge per passenger. Compared to the setting of Yang and Zhang (2011) the aeronautical charge is lower in any case.

In order to evaluate regulatory options under the monopsonistic regime, p_a^{ms} can be applied to scenario 1 of section 1 as shown in figure 1. [4] Here the single-till regulation price-cap is the benchmark. As expected, the monopsony aeronautical charge curve is below the monopoly aeronautical charge curve for all values of time. Since the monopsony curve approaches the efficient airport charge as the value of time approaches infinity the monopsony constellation can lead to a higher social welfare than the monopoly configuration. Therefore within this set-up there are cases in which regulation becomes less necessary. To compare the above monopsony result with the situation of a regulated market three intervals can be discussed. For all $v < v_1$, p_a^{ms} is above the single-till and the dual-till price-cap. In this interval the monopsony aeronautical charge covers the airport costs associated with aeronautical services $\Pi_a(p_a^{ms}(v)) > 0$ and all other airport costs $\Pi(p_a^{ms}(v), p_c^{\pi}) > 0$. The dual-till and single-till price-caps are closer to the benchmark aeronautical charge p_a^e than the monopsony aeronautical charge, thus achieving a higher social welfare. Single-till and dual-till price-caps are binding for the airport so that it can not charge the higher monopsony aeronautical charge.

In the second case, where $v_1 \leq v \leq v_2$, the monopsony aeronautical charge curve is below the dual-till price-cap and above the single-till price-cap curve. Compared to the dual-till situation the monopsony aeronautical charge condition is binding for the airport and superior to dual-till-regulation, which is then redundant. However, single-till regulation generates a higher social welfare than deregulation and is binding for the airport. In the third case, where $v > v_2$, the monopsony aeronautical charge is below both price-caps. In this case the monopsony price results in a higher social welfare than any form of regulation, but cost recovery can not be achieved, $\Pi(p_a^{ms}(v), p_c^{\pi}) < 0$. Here p_a^{ms} is binding and the airport can not set higher aeronautical charges. Consequently, the airport will "suffer" deficits and will not be financially viable if the composite valuation of time is sufficiently high.

At this point it has to be noted, that these results are valid only for the case in which just one single airline is considered. In reality, however, often a competitive fringe has to be taken into account. Hence the airport could probably still achieve full cost recovery even at high levels of value of time, depending on the size of the competing airlines.

[4] For $n = 1$ it is not possible to generate two intersections of the efficient aeronautical charge with single-till respectively dual-till regulated charges within the positive range of v-values.

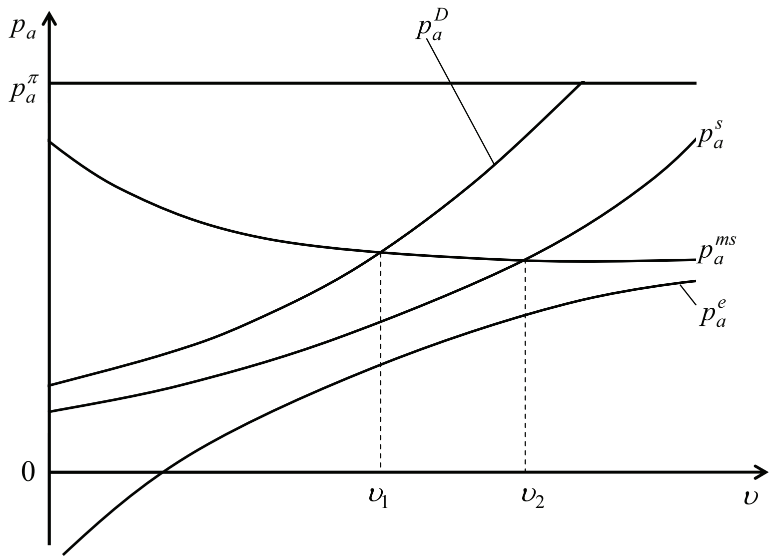

Figure 1: Scenario 1 and the monopsony aeronautical charge. Source: Own illustration based on Yang and Zhang (2011)

4 The Duopsony Case

In the second case the airport is dominated by two airlines and each carrier arrives at a certain degree of market power against the airport. Chicago-O´Hare, for instance, is dominated by both United Airlines and American Airlines, each using the airport as major hub and having a market share of around 30 percent (Fu et al. 2011). Similar to Brueckner (2002) we assume that both carriers compete in a Cournot fashion.

The revenue function for each airline is built upon the demand function, which is in the case of airline 1

$$\rho_1 = a - bq_1 - q_2 \ . \tag{13}$$

Samewise for airline 2

$$\rho_2 = a - bq_2 - q_1 \ . \tag{14}$$

Taking into account that $Q = \sum q_i = q_1 + q_2$ the ticket prices for airline 1 and 2 will be

$$p_1 = a - bq_1 - q_2 - \alpha\theta(q_1 + q_2) \tag{15}$$

$$p_2 = a - bq_2 - q_1 - \alpha\theta(q_1 + q_2) \ , \tag{16}$$

so that the revenue of airline 1 is

$$R_1 = p_1 q_1 \tag{17}$$

$$R_1(q_1, q_2) = [a - bq_1 - q_2 - \alpha\theta(q_1 + q_2)]q_1 \tag{18}$$

and thus the marginal revenue is

$$MR_1 = \frac{\partial R_1(q_1, q_2)}{\partial q_1} = a - 2bq_1 - q_2 - 2\alpha\theta q_1 - \alpha\theta q_2 \ . \tag{19}$$

The revenue and marginal revenue functions of airline 2 are analogous and can be omitted at this point. In order to determine the airlines' cost functions, the airport's supply function has to be defined. Analog to the monopsony case the airport's inverse supply function is

$$p_a(x_1, x_2) = c_a + tX \ , \tag{20}$$

where $X = x_1 + x_2$ describes the total input demand. We assume that both airlines pay the same aeronautical charge depending on the level of X. The cost function of each airline consists of congestion costs, airlines' unit operating costs and the aeronautical charge. Using the production function $q_1 = x_1$ and equation 20 the cost function of airline 1 becomes

$$C_1(x_1, x_2) = c_a x_1 + t x_1^2 + t x_1 x_2 + c x_1 + \beta\theta(x_1 + x_2)x_1 \ , \tag{21}$$

which implies that the marginal cost function takes the form of

$$MC_1 = \frac{\partial C(x_1, x_2)}{\partial x_1} = c_a + 2tx_1 + tx_2 + c + 2\beta\theta x_1 + \beta\theta x_2 \ . \tag{22}$$

The same can be applied for airline 2. Each airline maximizes its profits given the competitor's decision. The optimum level of input for airline 1 is

$$x_1(x_2) = \frac{a - c - c_a - x_2(1+t) - x_2\upsilon}{2t + 2b + 2\upsilon} \ . \tag{23}$$

This is airline 1´s reaction function to a given input of airline 2. The reaction function of airline 2 is similarly:

$$x_2(x_1) = \frac{a - c - c_a - x_1(1+t) - x_1\upsilon}{2t + 2b + 2\upsilon} \ . \tag{24}$$

Substituting equation (24) into equation (23) and vice versa gives the profit-maximizing input of each airline:

$$x_{1,2}^{ds}(\upsilon) = \frac{a - c - c_a}{2b + 3t + 3\upsilon + 1} \ , \tag{25}$$

where superscript ds denotes duopsony. Given the production function $q(x) = x$, total air travel demand takes the form of

$$Q = q_1^{ds}(\upsilon) + q_2^{ds}(\upsilon) = \frac{2(a - c - c_a)}{2b + 3t + 3\upsilon + 1} \ . \tag{26}$$

This implies that the duopsony aeronautical charge per passenger is

$$p_a^{ds}(\upsilon) = c_a + t\frac{2(a - c - c_a)}{2b + 3t + 3\upsilon + 1} \tag{27}$$

for each airline. In comparison to the monopsony case in section 3 the demand level is higher, resulting in higher aeronautical charges. The first and second derivatives

$$\frac{dp_a(\upsilon)}{d\upsilon} = \frac{-6t(a - c - c_a)}{(2b + 3t + 3\upsilon + 1)^2} < 0 \tag{28}$$

$$\frac{d^2p_a(\upsilon)}{d^2\upsilon} = \frac{36t(a - c - c_a)}{(2b + 3t + 3\upsilon + 1)^3} > 0 \tag{29}$$

show that, similar to the monopsony case, the duopsony aeronautical charge is decreasing and convex in the value of time, but at a higher level.

In the following we compare our results with Yang and Zhang (2011). For scenario 1 we can derive very similar results with those of the monopsony case and the interpretation remains

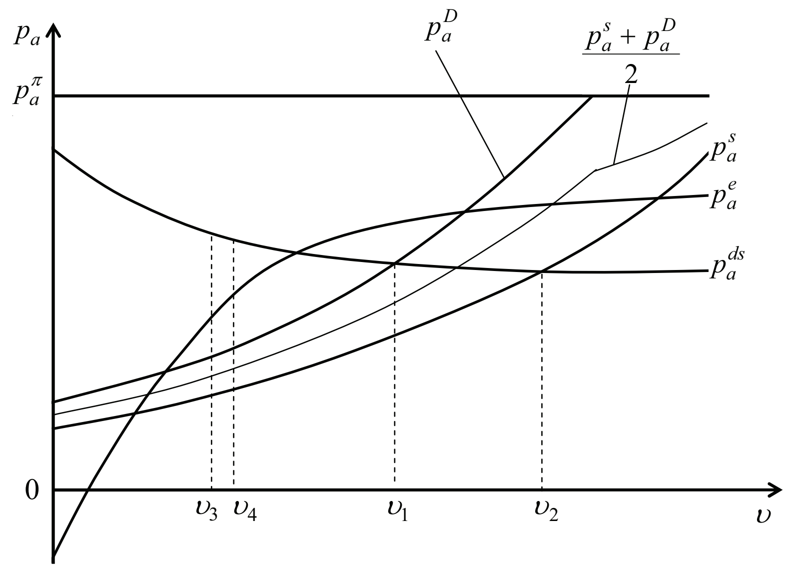

Figure 2: Scenario 2 and the duopsony aeronautical charge. Source: Own illustration based on Yang and Zhang (2011)

the same. In scenario 2, the efficient aeronautical charge intersects both, the single-till and the dual-till price-cap curves, as depicted in figure 2.

The efficient aeronautical charge is the benchmark. For $\upsilon < \upsilon_1$ the duopsony aeronautical charge curve is above both regulation charge curves, so that the latter are binding for the regulated airport. For $\upsilon_4 < \upsilon < \upsilon_1$ the duopsony aeronautical charge is closer to the benchmark than any regulated charge. In this case the abolishment of regulation leads to welfare gains (when considering only single-till regulation this interval extends to $\upsilon_3 < \upsilon < \upsilon_1$). The reason can be found in the quadratic and concave shape of the welfare function of the aeronautical charge. For $\upsilon_1 \leq \upsilon \leq \upsilon_2$ the duopsony aeronautical charge is lower than dual-till and higher than single-till regulated charges. The duopsony price is binding for a dual-till regulated airport. Thus, the airport will not charge the price-cap regulated charge due to the airlines' market power. However, dual-till regulation would yield higher social welfare than the unregulated option: in this case airline market power leads to losses in social welfare. For a single-till regulated airport the situation is similar to the implications derived for the first interval. The unregulated option outperforms single-till regulation, but the charge under single-till regulation is binding. Again the abolishment of regulation would lead to welfare gains. In the third interval, where $\upsilon > \upsilon_2$ the duopsony aeronautical charge is lower than both regulated price-caps. Hence, airline market power neither leads to airport cost recovery nor to an increase in social welfare. In general, scenario 2 shows that single-till regulation generates welfare losses in comparison to the unregulated option if the value of time is relatively low or intermediate. This result is also valid for intermediate values of time with respect to dual-till regulation. However, beyond intermediate time valuation airline market power prevents higher social welfare, which would result out of the dual-till regulation.

We now consider scenario 3, where the efficient curve intersects only the single-till curve. The resulting situation is depicted in Figure 3.

Again the efficient aeronautical charge curve is the benchmark for comparisons. In the first interval, where $\upsilon < \upsilon_1$ the duopsony aeronautical charge is higher than both regulatory options, which are binding for the airport. The aeronautical charge under dual-till regulation is closer to the benchmark than the unregulated option and, therefore, leads to higher social welfare: regulation should be maintained. The same applies for single-till regulation if $\upsilon \leq \upsilon_2$. For $\upsilon_2 < \upsilon < \upsilon_1$ the duopsony aeronautical charge is closer to the benchmark than the single-till

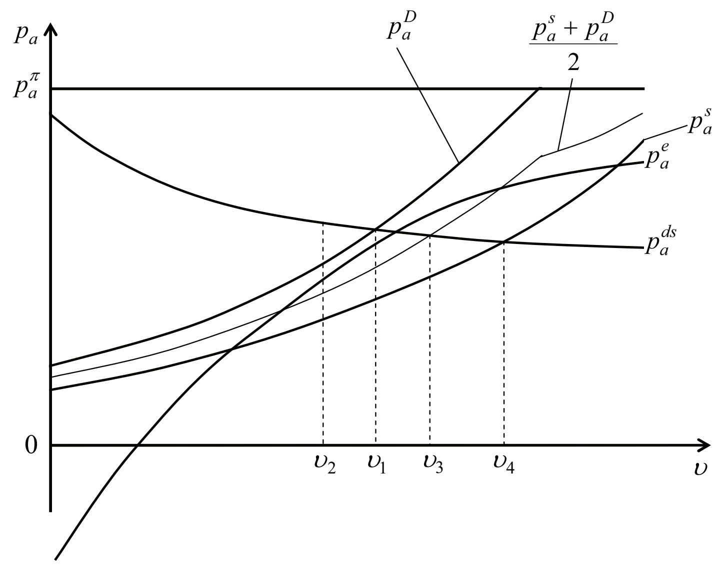

Figure 3: Scenario 3 and the duopsony aeronautical charge. Source: Own illustration based on Yang and Zhang (2011)

option. In this case, if there is no regulation the airport would adopt the higher duopsony charge, which would increase social welfare. For $\upsilon_1 \leq \upsilon \leq \upsilon_4$ the duopsony aeronautical charge curve lies between both price-cap curves and outperforms single-till regulation, since it is closer to the efficient charge. However, this condition is not binding. An abolishment of single-till regulation would lead to welfare gains. For $\upsilon_1 < \upsilon < \upsilon_3$ the duopsony aeronautical charge achieves a higher social welfare than the dual-till aeronautical charge. For $\upsilon_3 < \upsilon < \upsilon_4$ it is not possible to test superiority of each regulatory option. In the remaining interval where $\upsilon > \upsilon_4$ again no stable equilibrium can be reached. To sum up, scenario 3 shows that the abolishment of single-till regulation leads to welfare gains if the value of time is intermediate. This is also valid for dual-till regulation, however in a narrower interval.

5 Conclusions

Conventional regulatory approaches assume that airports possess monopoly power and may exploit it against airlines. This paper tests regulatory options for the opposite case, notably where airlines possess bargaining power and therefore can, at some degree, take influence on landing fees. This means, we hypothesize, that airlines possess mono- or oligopsonistic power and may use it against the airport. Real world observations indicate that this might be the case. To the knowledge of the authors this kind of approach is underexplored in existing literature. However, assuming mono- or oligopsonistic power leads to two major difficulties. First, from a theoretical perspective, for the airport-airline relationship one could start with the assumption of a bilateral monopoly. There are several possibilities to treat such economic relationships. We assume that airlines always have an exit option and, therefore, they possess the whole potential of mono- respectively duopsonistic power. This, however, might not hold in reality. For this reason we note, that in reality deregulated airport charges are possibly higher, than in this paper assumed. Second, we only cover two of various possible cases, namely the monopsony and the duopsony case, where airlines compete in a Cournot fashion. Further cases such as duopsony where airlines compete in a Stackelberg fashion, or a monopsony with a competitive fringe are also conceivable. Insights from tolling literature (e.g. Brueckner 2002) show, that in such cases airline input demand depends also on the behaviour of competitors. Monopsonistic power may therefore decrease. Since a competitive fringe can be observed for the majority of the airports, it is plausible, that mono- and duopsonistic discounts of landing fees decrease. The results of this paper should therefore be taken with caution. Nonetheless, we find that in both considered cases and under the described pure text book conditions the deregulated airport charge is a decreasing and convex function of the composite valuation of time of airlines and passengers. This finding changes optimal regulatory options. In general, single-till regulation outperforms dual-till regulation. In addition to this, and especially for intermediate congestion levels, airport deregulation could be a worthwhile option, despite the fact, that our approach considers neither the regulatory costs nor the associated political distortions. Furthermore, this model does not incorporate demand complementarities between the aviation and non-aviation sector: revenues from concession services are incorporated by use of a density function. Following Starkie's (2002) arguments, demand complementarities may provide even stronger incentives to lower airport charges. However, incorporating mono- or oligopsony airline power in airport regulatory models may not be an easy task for regulators since it requires very detailed information and hence increases regulatory costs.

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