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INVERTING THE REGULATORY RULES?

OPTIMIZING AIRPORT REGULATION TO ACCOUNT FOR COMMERCIAL REVENUES

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Inverting the Regulatory Rules?

Optimizing Airport Regulation to Account for Commercial Revenues

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Abstract

This paper analyzes the role of commercial revenues in today's airport regulatory system. We find that the current regulatory regime only partially achieves core aims such as welfare maximization. After highlighting instances in which airport price regulation is not economically justified, we explore the potential for airports to exercise market power in the commercial sector. In certain circumstances, we advocate the introduction of an "inverted" dual till system under which commercial as opposed to aviation revenues are the focus of price regulation. The suitability of such a system varies from airport to airport, however, depending on various factors, such as the airport's competitive environment and the presence of capacity constraints.

Keywords: Airport regulation, non-aviation revenues, price differentiation, single till, dual till

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1. Introduction

The growing privatization of airports since the early 1990s has led to a structural change in the airport industry. Airports are no longer mere departure and arrival points for passengers – they have become providers of a wide range of commercial services, from shopping and dining to car rental and currency exchange. In this way, the economic success of airports is increasingly linked to business activities outside of the aviation sector. The rising importance of commercial revenues has stimulated increased investment in the expansion of commercial services and has significantly changed the revenue structure of airports. Yet as airports have become more profit-oriented, regulators have moved to place caps on airport profit levels.

However, the aim to utilize the given airport capacity efficiently has not been achieved by installing a dual-till price-cap regulation. Instead, airport charges remain rather undifferentiated, lacking a clear price signal to indicate scarcity of resources during peak hours. Additionally, the price structure and revenue levels on the commercial side appear exploitative.

In order to maximize welfare in the non-aviation sector, i.e. allowing extraction of locational but not monopoly rents, and provide adequate price differentiation in airport charges, an inverted dual-till regulatory scheme may outperform the conventional dual-till scheme. This paper tries to outline supporting arguments for the adoption of an inverted regulatory regime.

The structure of this paper is as follows: Sections 2, 3, and 4 are coping with the interrelationships between aviation and commercial services at airports by assessing the role of commercial revenues, regulatory incentives, and the role of the regulatory basis. A key focus in this regard is on regulatory issues; we assess regulatory alternatives with regard to their efficiency and impact on airport sectors. Furthermore, we question the current role of the commercial sector in regulation by devoting special attention to the incentives set in pricing issues. We find that existing regulatory regimes only partially achieve core aims such as the welfare maximization. In particular, existing regulatory regimes fail to provide the right incentives for differentiated airport pricing, thus weakening the key role of prices in resource allocation. The following sections 5 and 6 deal with regulatory options in light of rising commercial revenues. After identifying circumstances in which no adequate justification for regulatory interventions exists, we present alternatives to the existing regulatory systems. The main focus of this analysis lies on the potential for airports to exercise market power in the commercial sector. We explore whether there is enough evidence to justify regulation of the commercial sector and analyze the potential consequences of such intervention on the aeronautical sector. Finally, concluding remarks are offered in section 7.

2. The role of commercial revenues

While airports formerly earned the biggest share of their revenues from aeronautical services, the success of today's airports depends increasingly on the commercial sector. The significance of commercial revenues is determined by a variety of factors, including passenger volumes and the competitive environment as well as local cultural and developmental factors.

Region	Commercial revenues ($ billions)	Commercial revenues as % of total revenues	Commercial revenues per passenger ($)
Africa/Middle East	1.80	52.9	8.00
Asia/Pacific	6.92	45.7	7.06
Europe	16.61	48.1	12.15
Latin America/Caribbean	0.85	29.0	3.13
North America	9.05	52.6	5.92
Total	35.23	48.1	8.06

Table 1: Share of commercial revenues by region, 2006. Source: Own illustration based on Graham (2008a)

Table 1 (giving an overview of the share of commercial revenues by world regions in 2006) shows that the structure of revenues varies significantly by airport region. While only 29 percent of total revenues stem from non-aviation activities in Latin America and the Caribbean, in regions such as North America, Europe, and the Middle East the share of commercial revenues amounts to about 50 percent. Furthermore, the share of revenues from commercial services is heavily influenced by total passenger numbers. A study of 31 European airports has shown that, on average, commercial revenues only make up 31 percent of revenues at airports with annual passenger volumes of less than 4 million. With increasing passenger volumes of 4 to 20 million p.a., this figure increases to 45 percent. Furthermore, at airports with over 20 million passengers annually, the share of revenue from commercial activities is even higher with up to 56 percent (see Graham 2008b, pp. 107). Even more compelling figures are reported in the Airport Retail Study 2006-2007 (see The Moodie Report 2007), which finds that the commercial revenue share at airports with more than 20 million passengers per annum is twice as high as at airports with less than 10 million passengers. In this way, increasing passenger volumes are associated with a higher share of revenues from commercial services and a corresponding decline in revenues from aeronautical services.

However, as non-aeronautical services are very heterogeneous, it is important to identify the components of this revenue source. According to Graham (2008b, pp. 108), retail services[2] are the most significant[3], representing 22 percent of worldwide non-aeronautical revenues. Other sources are car hire, car park, property business, and advertisement.

In the commercial property business at the airport, differentiated rental rates are charged in order to encourage the establishment of a diverse range of passenger services. This, in turn, helps to maximize non-aeronautical revenues. An additional trend that can be observed is for airports to provide land for the establishment of businesses not related to aviation, i.e. non-complementary services.[4]

Commercial activities can have a significant impact on aeronautical charges. Several models have shown that extensive commercial activities decrease airport charges paid by airlines (see Starkie and Yarrow 2000; Zhang and Zhang 2003). To a certain degree, lower airport charges can raise passenger volumes and therefore increase an airport's capacity utilization,

[2] Retail includes duty and tax free shopping, specialty shops, food & beverages, and bureau de change.

[3] The importance of retail revenues can be seen in the many retail investment projects undertaken at airports in recent years. Hamburg Airport, for instance, recently added 7,080 m^2 of retail space behind the passenger security screen (see Morrison 2009, pp. 112).

[4] At Perth Airport, for example, a brick factory has been constructed (see Morrison 2009, pp. 113).

revenues and, in turn, cost recovery. Possible losses witnessed in the aeronautical sector can be counterbalanced by revenues of the commercial sector.

However, at capacity-constrained airports cross-subsidization may lead to allocative inefficiencies. Increasing commercial revenues are not translated to higher passenger volumes, but rather to inefficiently low airside charges, since the price in this case does not reflect the degree of scarcity for a departure or arrival slot. In such a situation, the commercial sector obviously does not increase allocative efficiency. Renownedly, Europe's biggest international airports operate under capacity-constrained situations. For example, Charles de Gaulle Airport in Paris faces an excess slot demand of 13.9 percent. At Gatwick Airport in London, this figure is even 34.3 percent (see ACI 2004, p. 10-11). Non-aeronautical activities play therefore a major role in the revenue and charging regimes of airports.

3. Incentives under the current regulatory framework

The regulation of airports is justified in economic theory based on the notion that privatization grants airports considerable market power. Prior experience with the privatization of the British telecommunication and gas industries, for example, led to concerns that airports would abuse their market power by raising charges, thus creating deadweight losses (see Littlechild 2004, p. 6). Appropriate regulation tries to prevent the creation of such inefficiencies.

The current airport regulatory model primarily relies on price-caps and rate-of-return (RoR) regulation. The latter is the traditional form of regulation, and fixes profit levels as a function of costs respectively capital. The aim is to allow the airport an appropriate rate of return on invested capital while preventing undue profits (see Guthrie 2006, p. 930). However, the implementation of this regulation raises numerous problems such as the Averch-Johnson effect[5]. Moreover, cost-based regulation can hinder the development of non-aeronautical airport services (see Niemeier 2002, p. 41) and lacks incentives for price differentiation, particularly for demand-driven pricing.

By contrast, high-powered incentive schemes such as price-cap regulation provide better incentives for productive efficiency. Laffont and Tirole (2000, p. 37) point to evidence indicating that high-powered regulatory regimes lead to lower average prices. While similar evidence is reported by Braeutigam and Panzar for the US telecommunications industry (1993, p. 197), these authors state that price-cap regulation is likely to be an effective intermediate step in the transition to total market deregulation. Furthermore, price-cap regulation appears to set greater incentives for price differentiation according to demand elasticities (see Vogelsang and Finsinger 1979, pp. 20-21). Yet aside from the fact that prices in a price-cap environment can be subject to intertemporal manipulation (see Foreman 1995, pp. 336-339), incentives for differentiated pricing can also be lowered by mixing cost-based with

[5] Incentive created by RoR regulation to engage in excessive capital investment in order to enhance granted profits. Doganis (1993) has shown that RoR-regulated airports operate with significantly higher costs than price-regulated ones.

price-based regulatory rules, a hybrid policy which is used by airport regulators in many cases.[6]

In the past all reforms of airport regulation have failed to set the right incentives for differentiated pricing, despite the use of sliding scales. In almost all cases airports have continued to use the traditional two-part tariff combining weight and pax load dependent charge components. However, it is now generally acknowledged that this pricing structure does not enhance efficiency since it does not account for scarcity in airport capacity (see Starkie 2005, pp. 6-7). In the very few cases in which peak-load pricing has been introduced, airports have faced strong opposition from airlines (see Schank 2005). Ramsey pricing has only remained a theoretical possibility.

4. The role of the regulatory basis

In order to assess the reasons for the aforementioned failure to establish differentiated pricing, we analyze the regulatory environment of price-based airport regulation. Both single- and dual-till regulation set caps on the level of aeronautical charges. However, the single-till approach includes both aeronautical and commercial revenues (see Czerny 2006, p. 3); only the dual-till approach focuses solely on the former source of revenue.

The discussion as to which approach is preferable is controversial. Beesley (1999) asserts that regulatory activities should only concentrate on the natural monopoly sector of aviation, and that the commercial sector should be ignored. By demanding that aeronautical costs can only be recovered by revenues of the same sector, the dual-till approach can lead to more efficient capacity utilization due to increasing aeronautical charges as well as to better investment timing for airports with scarce airside capacities (see Starkie 1998, p. 115). Furthermore, airports have great incentives to invest in the development of commercial activities in order to maximize total profits (see Graham 2008a, p. 117). With regard to airports without scarce capacity, the exclusion of the commercial sector from regulation can lead may not yield the same results.

Airlines, however, obviously favor the single-till approach[7], as it includes incentives for the airport operator to use high commercial revenues to cross-subsidize airport charges. Due to the complementarity of aeronautical and commercial services (see Starkie and Yarrow 2000, pp. 2-3), lower take-off and landing fees may attract additional air traffic and increasing passenger numbers, which in turn can lead to growing commercial revenues. At already capacity-constrained airports with an extensive commercial sector, this form of cross-subsidization

[6] The so-called sliding scales represent a profit sharing rule between airport and airlines and have been often suggested as a possible means to counter regulatory risks on investments. For an in-depth analysis, see Borrmann & Brunekreeft (2009).

[7] The airlines' core argument is their responsibility for high passenger and thus customer volumes due to the complementarity of aviation and non-aviation services, even though the airlines do not profit from generated commercial revenues (see Graham 2008a, p. 117).

within the single-till regulation can create inefficient pricing strategies in the aeronautical sector.[8] Thus an increase in aeronautical charges at such airports would actually be more appropriate in order to properly indicate scarcity of airside capacity. In a dual-till environment cross-subsidization is not an issue.

Hence, it can be concluded that the implemented regulatory system should take the degree of capacity utilization at each airport into account. From a welfare point of view, Yang and Zhang (2011) have shown that optimal social welfare can be achieved with both regulatory alternatives, assuming that cost-recovery is not a problem. However, according to the authors single-till regulation performs better at highly congested airports as well as at airport with absolutely no congestion problem. Dual-till regulation works best for airports with medium congestion problems (see Yang and Zhang 2011, pp. 15-16).

Furthermore, the present slot allocation system does not ensure that slots are allocated to airlines with the highest willingness to pay. In this way, relatively low aeronautical charges at congested airports can attract airlines with a rather low slot valuation, leading to social welfare losses.

Alongside the direct impacts of regulatory restrictions placed on the aeronautical sector, there are numerous impacts to the commercial sector. As mentioned above, increasing demand for aviation services leads to growing demand for commercial services (see Lu & Pagliari 2004, pp. 15-16). Congested airports, however, are less interested in merely attracting additional passengers as they are in attracting passengers with high spending power. It can be assumed that airlines with a higher willingness to pay for slots also carry high-valued passengers, who are likely to spend more on non-aeronautical services. To the extent this is actually true a dual-till system incentivizing price-differentiation[9] is able to generate higher social welfare through efficient slot allocation and additionally raised commercial revenues.

The problem of excess demand during peak periods is still faced by many airports, however. Under a cost-based regulatory process, airports have insufficient incentives for price differentiation in the aeronautical sector, which leads to an inefficient use of airport capacity. When this is true, price-cap regulation seems to be more appropriate for capacity-constrained airports. If, however, airports do not differentiate their take-off and landing fees with respect to peak loads, a revised slot allocation system is needed. Because the present system is mainly based on grandfather rights, slots are not assigned to the airlines with the highest willingness to pay and thus no demand-based pricing can be assured.

A further problem is connected to capacity investment strategies, which are essentially based on resource requirements during peak times. RoR regulation in particular can lead to distortions in investment incentives. At London Stansted in the late 1980s, for example, an

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[8] Yet from a practical perspective, regulators require detailed information on the shape and nature of the commercial as well as the aviation sector in order to precisely isolate respective revenues. Due to the incentives for cross-subsidization this is a serious challenge for regulators (see Lu and Pagliari 2004, pp.3-4)

[9] In the sense of differentiation of prices according to the airlines' willingness-to-pay as well as peak loads. It is acknowledged that existing charging schemes already differentiate with respect to aircraft weight, noise emissions and nightly aircraft movements etc (see Knockaert et al. 2009, pp. 12-18).

additional terminal was built leading to excess capacity and many years of financial losses (see Graham 2008a, p. 115). Capacity expansion decisions based on peak utilization lead to excess capacity during off-peak times in both the aeronautical and commercial sector. Consequently, especially at dual-till regulated airports where price-caps inhibit the adjustment of airport charges in order to refinance airside capacity investment expenses, airports have to rely on revenues of the commercial sector. This, in turn, can lead to further commercial-sector investments.

Airport security is also impacted by inefficient demand allocation. When no peak-load pricing system is in place, passengers face higher costs during demand peaks in the form of longer waiting times at check-in counters and security screens. In commercial services, similar problems can emerge for staffing.

5. Is airport regulatory intervention justified?

This section analyzes whether airport operations actually fulfill the preconditions to justify governmental intervention. We concentrate on the competitive potential of airports in terms of intra- and intermodal competition.

Clearly, the airport market is not one of perfect competition. As runways and terminals represent indivisible commodities, airports occupy a natural monopoly position (see Sharkey 1989, p. 75) since aeronautical services are usually considered to be a monopolistic bottleneck. While the case for regulating airports can be found in nearly every standard economics textbook, whether or not the aviation sector represents a natural monopoly is a subject of intensive debate among economist.

In his study of the British airport sector, Doganis (1992, p. 48) finds a decrease of average costs until passenger volumes of 1.5 million. Furthermore, he observes no evidence for the existence of diseconomies of scale for large airports, and concludes that bigger airports have lower unit costs than smaller airports. The ICAO (2000, p. 3) arrives at similar results. Other researchers (Pels, Nijkamp and Rietveld 2003, pp. 341–61) separate passenger handling from aircraft movements. Using data envelopment analysis as well as stochastic frontier analysis, Pels et al. determine that the average European airport realizes constant returns to scale in the case of aircraft movements and increasing returns to scale when handling passengers. These results are supported by Gillen and Lall (2001, pp. 283–306) for the US airport sector.

Nevertheless, the question as to whether airports are natural monopolies has not been definitely answered. Niemeier (2002, p. 39) concludes that based on empirical evidence, secondary airports in Germany are operating under constant returns to scale for up to 150,000 aircraft movements per annum. He finds weakly increasing returns to scale for passenger movements up to a yearly passenger volume of 12.5 million.

An additional consideration in this regard is the existence of irreversible costs that can lead to barriers to entry for intramodal competitors. Airports are characterized by high fixed costs for infrastructure investments like runways and terminals. Whether these costs function as a barrier to entry depends on the amount of investment and time required. In the case of the construction of a new airport, a significant amount of time and extensive capital investments

are needed. Thus, a potential entrant has certain disadvantages compared to airports already operating in the market.

However, successful market entry can be possible under certain circumstances. In case an incumbent airport is capacity-constrained, there could be a sufficiently high excess demand to be served by the entrant. In addition to that the above described inefficient slot allocation process may also prohibit operations of airlines with a high willingness-to-pay for slots. Depending on the share of rejected high-value airlines and the particular size respectively cost of the newcomer's infrastructure, the resulting market equilibrium may enable a successful market entry. We therefore conclude that even in the presence of irreversible costs, there are possibilities in which an entrant could operate in the market on a competitive basis. In this regard it must also be noted that the probability of successful market entry rises when existing infrastructure is available, e.g. in the case of an existing small airport or decommissioned military base. In such cases, the volume of required investments decreases.

The question as to whether regulatory intervention is justified also depends on the presence of intermodal competition. In the following, we discuss the potential for substituting aeronautical services with other means of transport, especially high speed rail. Using the current market shares as well as travel costs and times for Germany, Franz and Müller (2006, p. 27) conclude that rail transport has comparative advantages for travel distances of 450 to 600 kilometers. These advantages tend to decrease the greater the travel distance. Discrete choice analysis yields similar results. Gaudry et al. (1997), for instance, find that rapid transit is particularly valued in the short distance market. In this regard, Capon et al. (2003) review mode choice models. In the case of generalized travel times, travel costs and departure frequencies play the largest role in mode choice. Unsurprisingly, cross elasticities also vary with travel purpose. Travel time is much more important in the business travel segment than in the leisure market. The relatively high cross price elasticities in the leisure segment indicate that low air fares can lead to travel decisions in favor of air transport, particularly in the case of short travel distances. However, in contrast to train stations, airports tend to be located on the periphery of cities, necessitating additional travel time, a fact that is identified in many mode choice models as something that is valued negatively by passengers. Furthermore, the dense and high-quality rail network in Europe supports the claim that air and rail transport can be substitutes within certain distances. For these reasons, we conclude that within a trip length of about 700 kilometers other transport modes can be considered as potential substitutes. The intensity with which airlines and therefore also airports are exposed to intermodal competition thus depends highly on the ratio of short-haul flights in the airports' flight schedule. It can be assumed that international airports like Frankfurt and Munich are exposed to a low degree of intermodal competition due to their huge share of intercontinental flights. Here, feeder services via high speed rail are even complementary services since they can help relaxing the capacity constraint of huge hub airports.

Even if one assumes that some airports enjoy a degree of market power, it is uncertain as to whether airports will actually exploit it. Because airlines and especially home carriers are non-atomistic, their bargaining power can strongly influence the airports' price setting opportunities. The key question is to what extent airlines can credibly threaten airports with relocation in the case of rising service charges. A potential substitute airport must fulfill a variety of geographical and infrastructure requirements. Furthermore, relocation can entail substantial switching costs. Malina (2006) has examined the potential for airlines to relocate

to alternative German airports. The study finds that the potential of an airline to relocate is higher for airlines operating at secondary airports compared to international hubs.[10] In this way, serious bargaining may only be conducted by airlines using relatively small airports, because they have more switching opportunities.

Starkie (2002, p. 69ff.) provides an additional argument as to why airports cannot abuse their potential market power. According to Starkie, the existence of the commercial sector and the opportunity to extract locational rents in this sector drives airports to lower take-off and landing fees, as airports will naturally try to maximize profits in both sectors. On the other hand, the complementarity of both services may drive airports to abuse their market power in the commercial sector.

In conclusion, the general notion that airports' aviation services are natural monopolies and that airports are in a position to exploit market power should be viewed critically. As discussed above, factors that lead us to be skeptical of this general conclusion include limited econometric evidence on returns to scale especially for large airports, the possibility of market entry, intermodal competition in the area of short haul services, the substitutability of smaller airports, and the complementarity of commercial and aviation services. It is therefore likely that regulation of the aviation sector at several European airports is not justified.

6. An inverted dual-till approach?

Having addressed the question of whether the aviation sector should be regulated, we proceed with the possibility to regulate the commercial sector. Based on the foregoing findings, the following section analyzes an alternative to the existing regulatory systems in the light of the increasing importance of commercial revenues. We theoretically examine the potential market power of an airport in the commercial sector and discuss the effects of an "inverted" dual-till regulatory approach in which price levels are capped in the commercial sector but not in the aviation sector.

In contrast to the aeronautical sector, the commercial sector including retail, car hire, car park, property business and advertisement, is not typically assumed to fulfill the conditions for a natural monopoly. This sector neither shows subadditivity in the cost function nor extensive sunk costs[11]. Nevertheless, particularly at dual-till regulated airports, the prices for commercial services in the airport terminal are higher in comparison to the prices observed in neighboring local business districts. It is a matter of controversy as to whether these prices are based on the airports' location, or rather represent monopoly rents (Forsyth 2004). In the latter case, regulatory intervention would be justified.

It is not always possible to draw a clear distinction between locational and monopoly rents. The well-developed infrastructure around airports ensures good accessibility and may in the long run be regarded as a scarce good. In the case of retail concessions, commercial vendors

[10] This is likely due in part to infrastructure requirements, which are much greater for long-haul operations than for domestic or continental movements.

[11] An exemption may be the investment in parking areas or structures as well as terminal extensions.

may be willing to pay higher rental prices to the airport in order to gain access to higher revenues promised by a beneficial location. Higher rental prices are thus reflective of locational rents. However, the situation is quite different if the airport decides to artificially limit available rental space in order to exploit its market position to extract monopoly rents.

Furthermore, airports are also in a position to establish their own commercial operations. Due to profit imperatives, airports thus have an incentive to prevent the establishment of competing business. In this way, there is a high potential for airports to abuse market power in order to extract monopoly rents from the commercial sector, where users are atomistic.[12]

Using empirical methods, however, it is possible to distinguish between locational and monopoly rents. As noted above, higher prices due to the greater location-based attractiveness of airports would constitute locational rents. This attractiveness may be related to good infrastructure provision and ease of access. Indeed, accessibility is a factor often measured in hedonic price regressions on residential properties. Assuming that property markets are competitive markets, airport accessibility is incorporated into real estate market prices, reflecting the attractiveness of the airport and, in turn, its locational advantage. For example, Tomkins et al. (1998) in its study on Manchester airport find that the valuation of residential property decreases by about 22 percent when comparing properties directly adjacent to the airport to properties in distance of 16 kilometers ceteris paribus. However, another study by Püschel and Evangelinos (2011) find a statistically insignificant influence of airport proximity for the case of Dusseldorf airport. Due to the ambiguous results found and the lack of hedonic pricing studies on commercial properties incorporating distance to the airport no clear picture can be drawn on the issue of locational rents.

However, if there is a price premium for retail space rents at airports is comparison to off-site locations, it is fair to assume that monopoly rents are responsible. To conduct a closer analysis, data on rental contracts between airports and retailers is needed. Although we do not have access to such data, anecdotal evidence suggests that airport rental prices exceed the rent premium for accessibility described above. Sound econometric analysis is required to further clarify this question.[13]

It would be extremely difficult to implement an inverted dual-till regulatory system, however, because the goods and services offered in the commercial sector are very heterogeneous. Consequently, price-cap regulation in the retail sector would be highly questionable, both economically and legally. Revenue caps are thus the only feasible way of counteracting monopoly price setting by airports due to the fact that they would not directly interfere with the price setting of airports. Nevertheless, revenue caps can prevent the extraction of monopoly rents.

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[12] It remains an open question as to what extent potential airport customers are captive customers, since most of the commercial non-aviation related goods and services offered at the airport site can possibly be substituted by off-site offerings. However, passengers in transit, behind the security or with a high value of time may represent captive customers.

[13] Alternatively, the construction of a weighted price index based on a basket of goods and services that are available at airports and the testing of this index according to spatial factors would deliver good insights as to the existence of locational rents.

Based on the assumption that a justified level of non-aviation revenues can be found, we now turn to expected welfare effect of an "inverted" dual-till regulation. Figure 1 depicts two demand functions $D_{com,\,1}$ and $D_{com,\,2}$ of different commercial services directly offered by the airport, e.g. parking and retail space.

It is assumed that marginal costs MC in both services are equal. Due to the missing regulation of the commercial sector in the regular dual-till approach the airport operator can set the monopoly prices p_1 and p_2 for the two commercial services.

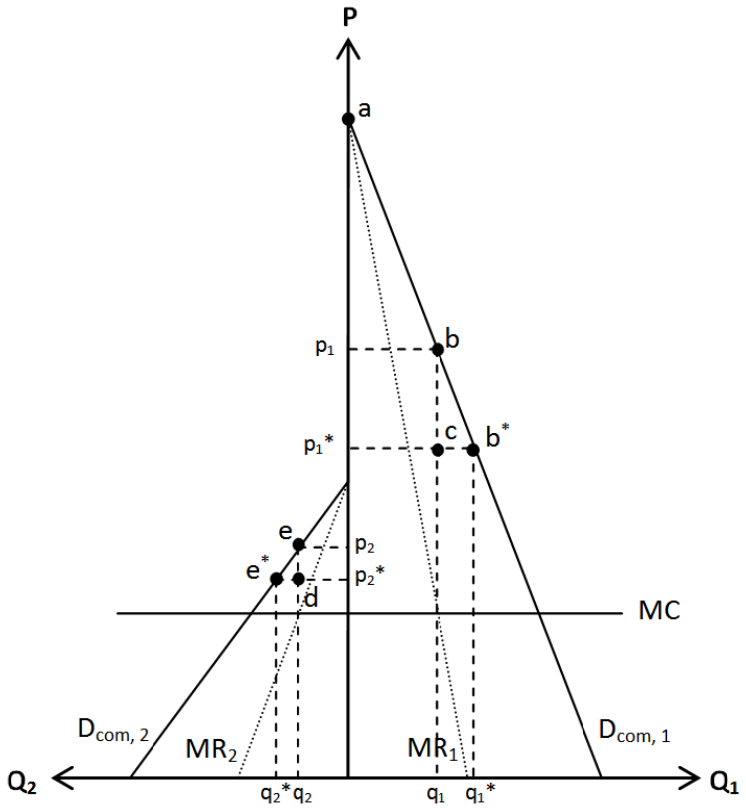

Figure 1: Welfare effects in the commercial sector under inverted dual-till regulation. Source: Own illustration based on Wied-Nebbeling (2009).

By implementing an "inverted" dual-till regulation the revenues of the airport in the commercial sector are capped, so that prices have to decrease. Assuming that prices for both services decline to p_1* respectively p_2*[14], the consumption also decrease from q_1 to q_1* and from q_2 to q_2^*.

Figure 2 depicts the aviation demand of the capacity-constrained airport using the airlines' slot demand curve D_{av}. Since the airport faces excess demand in a dual-till regulatory environment, airport charges are set lower than the market clearing price p_{MCL} at p_t equal to an average cost based price.

[14] It is also possible that not all prices decrease.

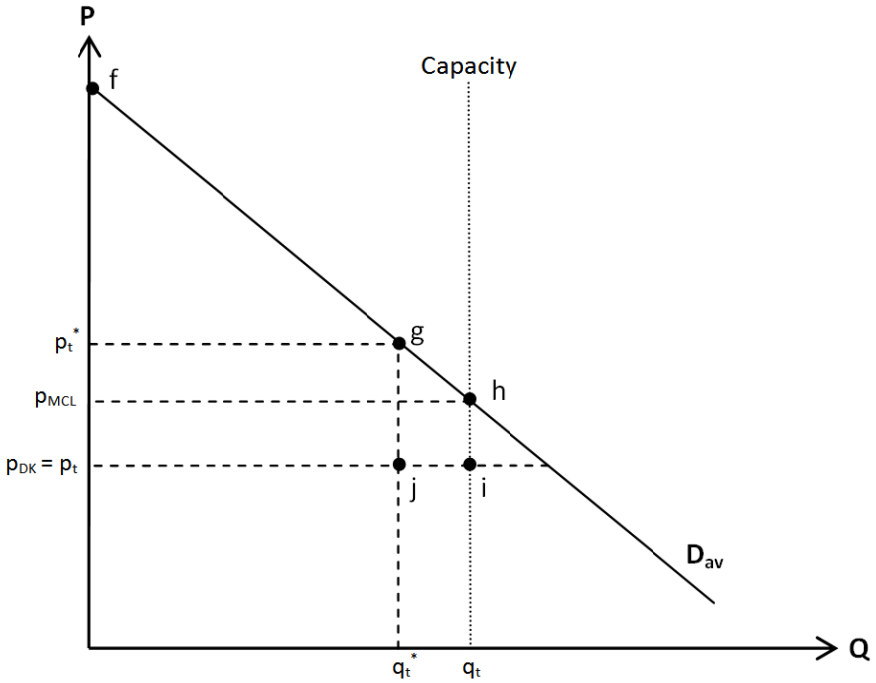

Figure 2: Welfare effects in the aeronautical sector under inverted dual-till regulation

An airport regulated under an "inverted" dual-till system may have some additional incentives to compensate for the decreased revenues in the commercial sector through additional revenues in the aeronautical sector, which is now deregulated. Thus, the airport operator will increase airport charges to minimum the market clearing price. With the freedom and opportunity to set prices in an economical way, price differentiation in the form of peak-pricing may take place: because aviation sector profits are not limited, profit maximization may drive airports to set prices according to demand elasticities.

However, there are also certain dangers. The new airport charge may be determined by monopolistic pricing. Airports can raise their charges to $p_t^* > p_{MCL}$. In this situation demand will decrease from q_t to q_t^*. Consequently, this form of regulation can lead to optimal or suboptimal resource utilization in the aeronautical sector depending on the particular market power of the airport. Because of complementary of demand, a price exceeding the market clearing level in the aeronautical sector can also decrease demand in the commercial sector.[15]

Furthermore, monopoly pricing in the aviation sector can lead to the development of "high priced" airports. High price levels may attract only airlines and passengers with high-value demand. To the extent this actually occurs, the commercial sector will be encouraged to offer premium goods and services. As a consequence, the "inverted" dual-till regulation leads to a shift in profits between both sectors.

[15] Assuming constant number of passengers per air traffic movement. However, bigger aircrafts can be used as a reaction to higher airport charges, so that total passenger numbers may not necessarily decline proportionally.

The relative welfare effects of this regulatory option depend in large part on the decisions of the airport management with respect to capacity utilization, as well as on the competitive situation vis-à-vis to other airports.

Commercial sector		
Consumer Surplus	Producer Surplus	**Welfare Effect ($\Delta W_{commercial}$)**
$+ p_1*b*bp_1$	$- p_1*cbp_1 + q_1q_1*b*c$	**+ cb*b**
$+ e*p_2*p_2e$	$- dp_2*p_2e + q_2*q_2de*$	**+ e*de**

Table 2: Welfare effects of inverted dual-till regulation in the commercial sector

As can be seen in Table 2, in the commercial sector a decrease of the services' prices leads to a welfare increase of

$$\Delta W_{commercial} = cb^*b + e^*de.^{16}$$

Table 3 shows welfare effects in the aeronautical sector. In contrast to that, deregulation of the aeronautical sector can lead to a decrease in social welfare. Total welfare decreases in the non-discriminatory monopoly case. However, if the airport operator perfectly discriminates airport charges, the welfare in the aviation sector remains constant.

Aeronautical sector					
Non-discriminatory monopoly			**Perfect discriminatory monopoly**		
Consumer Surplus	Producer Surplus	**Welfare Effect**	Consumer Surplus	Producer Surplus	**Welfare Effect**
$-p_tihgp_t*$	$+ p_tjgp_t* - q_t*q_tij$	**- ghij**	$- p_{MCL}hf$	$+ p_tihf$	**0**

Table 3: Welfare effects of inverted dual-till regulation in the aeronautical sector

In light of these findings, it is very important for the regulator to anticipate the right revenue cap in the commercial sector in order to avoid deadweight losses.

If the cap is set too high, reductions of commercial services' prices and in turn welfare gains in the commercial sector may be low or even negative. In case the airport operator is in knowledge of the actual shape of its slot demand curve, price-discriminatory behavior in the aviation sector is expected leading to no further distortions. However, if perfect information is not the case, the airport may behave as a non-discriminatory monopolist in the aviation sector setting uniform monopoly prices (see Laffont and Tirole 2001, p. 95), which may over-compensate welfare gains, so that in total welfare increases only marginally or can even turn into a deadweight loss. When lowering the revenue cap, welfare gains in the commercial sector increase. Additionally, reduced commercial profits may amplify the incentive to the airport operator to discriminate airport charges. Maximum welfare gains then are reached when the revenue cap yields market clearing prices in the commercial sector. In case the cap is set even lower, the airport will lack incentives to develop the commercial sector.

Based on the foregoing, we conclude that the decision to implement an "inverted" dual-till regulatory system should be based on parameters specific to each airport, such as capacity

[16] In the case that not all prices decrease in the commercial sector, $\Delta W_{commercial}$ has to be reduced by the respective addend.

constraints, intermodal competition, and airport competition. In addition, this scheme may give some additional incentives for price differentiation in the aviation sector, thus leading to increased allocative efficiency through optimal airside capacity utilization.

7. Conclusions

As commercial revenues are of growing importance in the airport industry, regulators should be better aware of their impact on regulatory outcomes. This paper explored how the commercial sector influences the effectiveness and efficiency of airport regulatory systems. Because of complementarities in demand between both sectors, price setting in the aeronautical sector is dependent on revenues from commercial services.

Ultimately, the efficiency of regulation is determined by the prevention of monopoly rents as well as an airport's capacity utilization. Particularly when airside capacity is constrained, price differentiation is essential for allocative efficiency. Such price differentiation in accordance to peak demands, however, does not take place in the airport sector.

Due to the very limited evidence of natural monopolies and the abuse of market power, we question regulatory actions in the aviation sector. In addition, because of the complementarity between the aviation and commercial sectors, airports may transfer their ability to abuse market power to non-aeronautical services. Additional research in this regard is still required, however.

By introducing an "inverted" dual-till regulation for capacity-constrained airports commercial revenues are capped while the aviation sector of an airport is deregulated. Our analysis has shown that through this scheme total welfare gains can be achieved. It remains the question in which way the welfare-maximizing commercial revenue cap can be determined correctly and if airports will actually exploit its possibility to set airport charges freely.

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