"Spatial Price Discrimination in Airline Markets – Theory and Evidence"

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Abstract:

Spatial price discrimination is a feature not generally associated with the airline industry. If a firm is able to discriminate prices according to the traveling distances of consumers, it would charge a premium to those who live close by and offer discounts to those customers with long travel distances, thereby achieving a greater catchment area and eventually greater profits. Airlines are generally not able to conduct such a pricing, since they do not know where their passengers arrive from. The notable exceptions are airlines with a hub-and-spoke network structure. These airlines are able to distinguish between transferring and direct flying passengers. This paper will first present the theoretical background of spatial price discrimination. Then an empirical investigation looking into the pricing behavior of European airlines will follow. Offered online prices by three European carriers are being analyzed, including prices for direct and connecting flights from (or via) their respective main hubs.

Keywords: Airline Economics, price discrimination, airline pricing

1. Introduction

Spatial price discrimination is a feature one would not straightaway associate with the airline industry. If a firm is able to discriminate prices according to the traveling distances of consumers, it would want to charge a premium to those consumers who live close by and offer discounts to customers with long travel distances. Thereby the firm could achieve a greater catchment area and eventually greater profits. As with many forms of price discrimination, the firm would need to establish a mechanism to distinguish consumers with long travel distances from those with shorter distances in order to avoid arbitrage. The firm could for example ask consumers to present some identification to verify their home addresses or something else. That way the firm is able to formulate price offerings such as "if you live more than … away and shop at our store you get a … discount". Ideally however the firm knows the exact travel distance of every consumer and the associated costs. By these means the firm would be able to establish what is called perfect spatial price discrimination.

Airlines are generally not able to conduct such pricing since they neither know where their passengers arrive from nor the associated costs of travel. The notable exceptions, however, are airlines with a hub-and-spoke network structure as these airlines are able to distinguish between transferring and direct flying passengers. For example, it might be profitable for Lufthansa to charge a premium to customers taking a direct flight out of Frankfurt or Munich to an intercontinental destination, while offering a discount to passengers who need to take a connecting flight first in order to get into Frankfurt or Munich. The passenger in Frankfurt airport's catchment area is locked-in. It is unlikely that passengers living in Frankfurt airport's catchment area will choose a competing airline over Lufthansa (or one of its alliance members), because this would require an additional connection into another hub. The airline has a clear and unambiguous attribute with which it can indentify passengers who qualify for the discount. Moreover, the carrier can avoid arbitrage by requiring each passenger to fly in the exact order the ticket is purchased. Otherwise passengers could book a connecting service via the hub with the intention to start the journey in fact at the hub. In doing so, the airline is able to offer discounts to passengers taking a connecting service and overprice direct services out of the hub. This is in effect an example of spatial price discrimination.

To the author's best knowledge no study exists to verify whether airlines actually carry out spatial price discrimination. What is known is that there exists a so called hub premium. This basically states that all flights out of a hub are generally more expensive than all other connections the airline offers. The degree to which this is done varies according to different empirical studies (Borenstein, 1989; Lijesen et al, 2001). There is also a broad literature on the topic of spatial competition (Hotelling, 1929; Greenhut et al, 1987) and the welfare effects of spatial price discrimination (Holahan, 1975; Hwang & Mai, 1990). Yet, specific references to airline pricing in the context of spatial price discrimination do not exist. This paper aims at closing this gap by finding out whether airlines actually conduct spatial price discrimination and what the consequences for economic policy might be. A small empirical inquiry is carried out showing averaged prices and price differentials for indirect and direct routes that is intended to invite further research into this matter.

Following this introduction, sections 2 and 3 review the theoretical background of pricing behavior in spatial models and show why it might be profitable for airlines to engage in spatial price discrimination. First, the pricing behavior of a monopolist under uniform pricing and spatial price

discrimination will be compared. Second, the same pricing schemes will be compared for two firms that compete against each other. To find out whether spatial price discrimination is indeed an issue for airlines, an empirical investigation will be carried out in section 4. Offered online prices by the European carriers Lufthansa, British Airways and KLM-Air France are examined. Direct and connecting flights from (or via) the airlines' respective main hubs to one medium-haul European and two intercontinental destinations will be compared. A summary and conclusion will round up this paper.

2. Spatial monopolist's pricing behavior

2.1 Uniform pricing

First, it is demonstrated how a spatial monopolist would set prices, given that no spatial price discrimination is feasible. The basic model design is similar to Fröhlich (2009) and follow in the footsteps of spatial models by Launhardt (1885 [1993]), Hotelling (1929) and Ferreira & Thisse (1996).[1] Here an intuitive explanation of the model is given using a graphical presentation instead of a mathematical formulation. Consider a spatial monopolist on a straight street. The firm's price is called the mill price and is denoted with p. Consumers face this mill price plus transportation costs for traveling from their respective location to the firm's location. These transportation costs are given by the consumer's distance to the firm multiplied by the transportation costs per unit of distance. With the latter denoted as λ, the total price or delivered price is calculated as $p_{a_j} = p + |a_j - \theta|\lambda$, where a_j is a consumer located somewhere on the street and θ is the firm's location on the street. Given certain exogenous factors such as length of the street, willingness to pay or a non-uniform distribution of consumers along the street, the firm will be able to exercise more or less market power. The following figure gives an impression of the model so far.

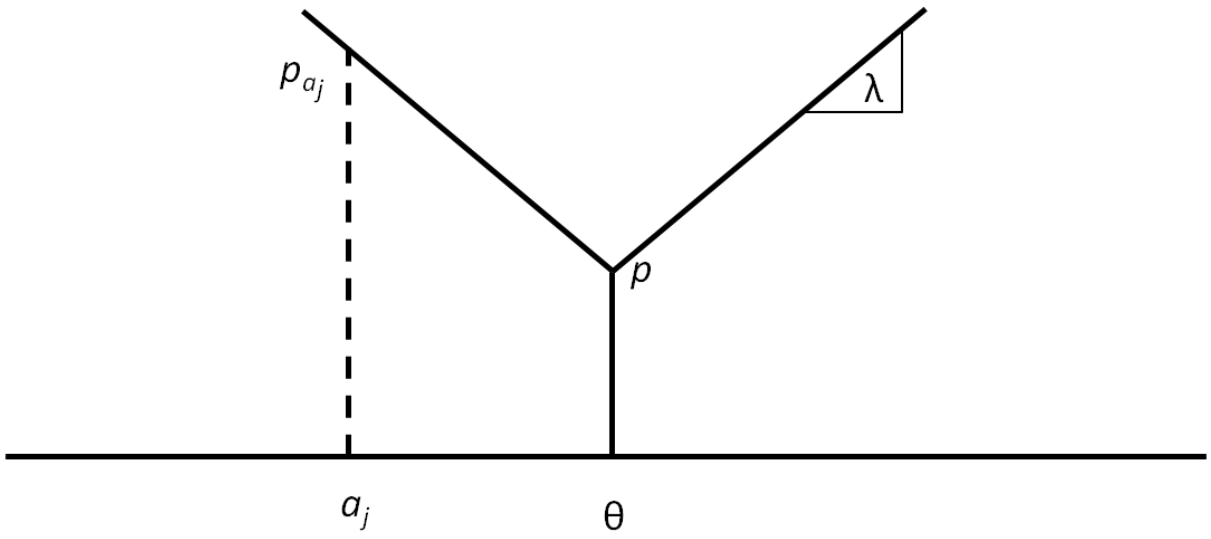

Figure 1 Spatial monopolist charging a uniform price

[1] For a comprehensive survey on models of spatial economics see Greenhut et al (1987).

Since passengers face transportation costs the firm might not be able to reach all passengers on the street for a given p. At some point consumers might withdraw from buying. Hence, the firm will take the transportation costs into account when setting its prices. The firm's profits will be low if λ is very large and will be high if the street length is large as more consumers are within reach. However, beyond a certain street length, the firm might not be able to reach all consumers on the street due to the transportation costs and a given willingness to pay. The described scenario is more or less the standard model for a spatial monopolist using a uniform price.

2.2 Spatial price discrimination

Now assume the monopolist knew every consumer's location on the street and the associated transportation costs. Furthermore, assume that the firm could charge each consumer an individual price. That way the firm could conduct perfect spatial price discrimination and charge every consumer according to the maximum willingness to pay. Assume that there is a uniform willingness to pay, labeled σ. In order to discriminate prices the firm charges each consumer their full reservation price minus their transportation costs. Essentially, the firm would pay every consumer the transportation costs that were incurred and the delivered price would be $p_{a_j} = \sigma + (|a_j - \theta|\lambda) - (|a_j - \theta|\lambda) = \sigma$. Hence, the mill price would be set for each consumer individually. The mill price for consumer a_j would be $p_j = \sigma - (|a_j - \theta|\lambda)$. Consequently, consumers located near the firm (and thus incurring low transportation costs) would pay a high mill price whereas consumers located farther away would be paying a low mill price. In Figure 2 below consumer a_j pays a lower mill price than a_k since $(|a_j - \theta|\lambda) > (|a_k - \theta|\lambda)$.

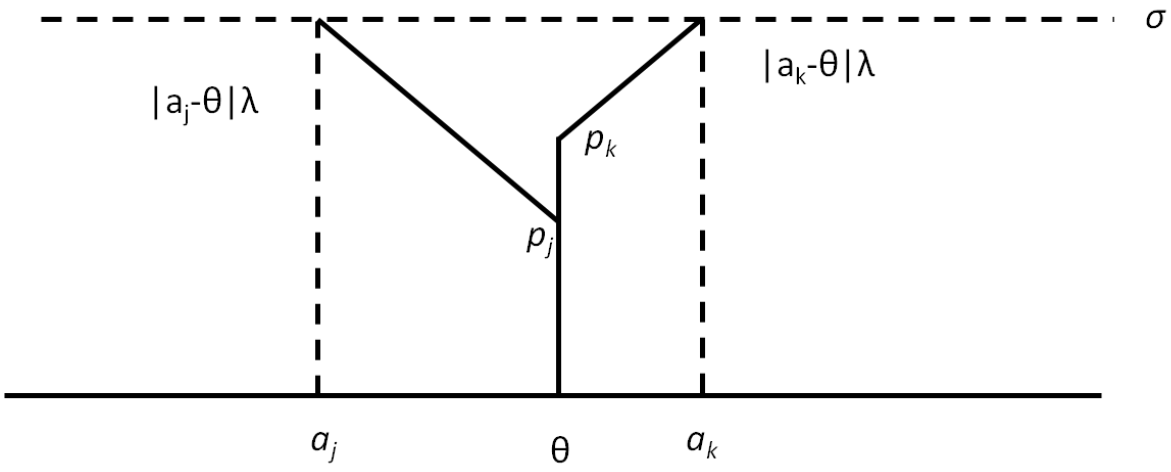

Figure 2 Perfect spatial price discrimination of a monopolist

Obviously, under such a pricing behavior the firm would have a greater catchment area and greater profits than under uniform pricing. The last consumer, paying a mill price of zero, would face transportation costs equal to σ.[2] Beyond that consumers would not buy at all. These results are

[2] That is, under the assumption of non-negative prices.

similar to the standard model of first degree price discrimination and the welfare implications are also comparable. From an individual profit maximizing perspective the firm will find it generally[3] more profitable to conduct spatial price discrimination compared to a uniform price regime.

The assumption so far was that there are no competing firms in the market, i.e. the pricing of a monopolist was analyzed. The next section looks at the effects of pricing decisions if a competitor is added to the market.

3. Pricing behavior under competition

In the case of more than one firm on the same street there is the question of where these two firms are located. This was in fact the original question of the seminal paper by Hotelling (1929). In a more long-run analysis, the firms' locations would need to be flexible anyway.[4] For the purpose of this paper, which is to analyze pricing decisions, it suffices to assume fixed locations for the firms. First, the manner in which uniform prices are set will be analyzed assuming that the two firms are located at the respective ends of the street. Then, the results of price discrimination will be discussed.

3.1 Uniform pricing

The usual procedure in spatial competition models that assumes a uniform price regime is to find the marginal consumer(s). If two firms are located at the respective ends of the street there will be one marginal consumer. This consumer is indifferent between the firms if the delivered price is equal for both. In Figure 3 a_j is indifferent between the two firms. If $p_1 = p_2$ the marginal consumer would be in the middle of the street and hence the two firms would split the market even. The trade-off that the two firms face is to lower the mill price in order to have a greater catchment area or to increase the mill price in order to get higher marginal revenue from the remaining consumers.

[3] The exceptions are cases for which there is a certain relationships between market size, willingness to pay and the transportation cost parameter λ. For situation in which there is a large market size and low willingness to pay it could be, for example, that the firm is indifferent between price discrimination and uniform prices or prefers a uniform and fixed price regime.

[4] For an article on this topic see Weber (1974).

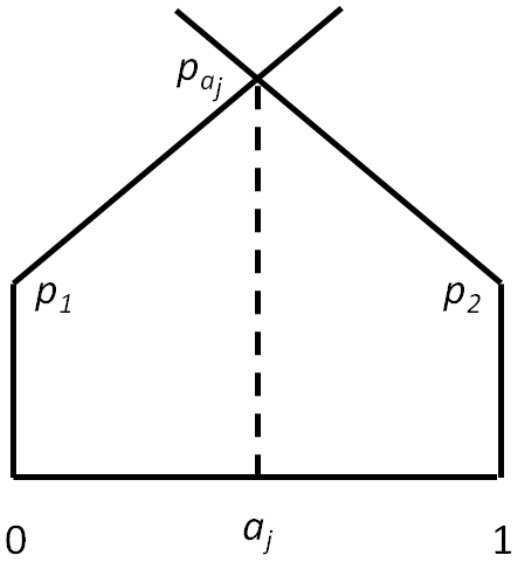

Figure 3 Spatial price competition with two firms

Under individual profit maximization the firms will set symmetric prices and will always share the market equally. Prices will be above marginal costs since the transportation costs imply a different willingness to pay and have the effect of creating alternating demand functions for the two firms. Thus, the result is similar to that of monopolistic competition and the transportation cost parameter has the function of a substitution parameter.[5] Direct price competition is limited because of the spatial distance between the competitors. Thus, under a uniform price regime, adding a spatial competitor generally curbs a spatial monopolist's market power, but only to a certain degree.

3.2 Spatial price discrimination and competition

Adding price discrimination to the picture intuitively implies fiercer competition since there is another domain in which the firms can compete. The question is what would happen if both firms were able to conduct perfect spatial price discrimination?

Recall from section 2.2 that in this case each firm is able to charge each consumer an individual price. This price equals the reservation price minus the transportation costs that were incurred by each individual consumer. Each consumer faces different transportation costs depending on the firm's location. Since each firm knows these transportation costs in advance, all consumers are indifferent between both firms. For one firm, for example, the distance might be very large, but since the consumer gets a discount, the mill price is very low. Alternatively, the purchase could be made at a store that is closer to the customer, but here the delivered price would be higher. In Figure 4 consumer a_j is indifferent between firms 1 and 2. Firm 1 charges a mill price of p_{1j} which is higher than p_{2k}. Conversely firm 2 charges a higher price for consumer a_k than firm 1.

[5] Again, this result may change if the reservation price falls below a certain threshold. If the reservation price, for example, gets very low each of the two firms becomes a spatial monopolist and results of the previous section apply. This is because the market is not completely covered and a gap in the middle of the street emerges in which consumers have withdrawn from the market because their delivered price exceeds their reservation price.

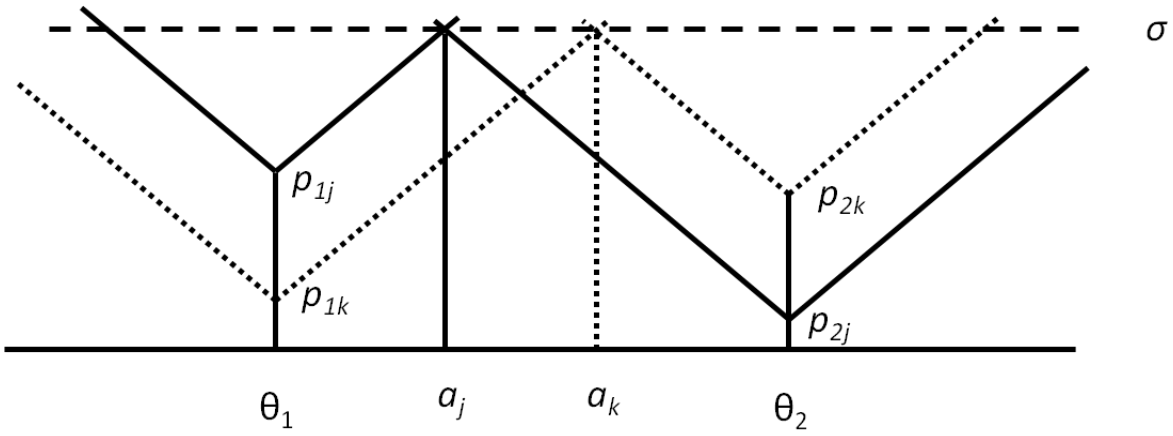

Figure 4 Perfect spatial price discrimination with two competitors

Since each firm knows the transportation costs of each consumer, the delivered price for any consumer along the street is always equal to σ. Thus, all consumers are indifferent between both firms.[6] The market outcome is unknown a priori and each firm would face demand uncertainty.

If one firm were to conduct perfect spatial price discrimination and the other not, the former might gain at the expense of the latter and the firm conducting the price discrimination would achieve higher profits. Essentially both firms have an incentive to engage in price discrimination. Thus, both firms end up discriminating prices. Assuming that these two firms get an equal market share (since all consumers are indifferent chances are fifty-fifty that a consumer chooses one particular firm) both end up earning higher profits than with uniform prices. Thus, from a theoretical standpoint one would expect that, all else being equal, firms will try to engage in spatial price discrimination.

4. Spatial price discrimination and airlines

4.1 Hub premium

Having elaborated on the theoretic foundations of spatial price discrimination in the previous sections, it is now time to turn to the example of airlines. As stated in the introduction, one would not normally expect to find examples of spatial price discrimination in air travel. Passengers book flights often through the internet. Airlines have a broad array of consumer research methods and might know from which town or city the prospective consumer is logging in and could theoretically adjust offered prices according to such parameters. The working hypothesis, however, is that airlines do not conduct such potentially illegal behavior. Thus, an airline does not know where its passengers are coming from or, even if it knew would do not base its pricing decisions on such information. The notable exception is when passengers need to take transferring flights to get to their final

[6] Again, this result can change depending on the interplay between the exogenous parameters. Furthermore, distance between the firms and the role of the firms' hinterlands will be important. Theoretically one could imagine that even consumers left of θ_1 are indifferent between firms 1 and 2 if firm 2 could still reach such consumers. This will be the case if the firms are relatively close to each other and the λ is low.

destination. Most legacy carriers operate hub-and-spoke networks and bundle traffic at their hubs. Thus, a passenger flying, for example, from Bremen to New York must at least switch planes once in Europe because there is no direct service to that destination. If the passenger chose Lufthansa for example, one possible itinerary would be Bremen-Frankfurt-New York. Based on such a purchase Lufthansa knows exactly that the passenger must come from somewhere near Bremen. Conversely, a passenger booking a direct flight from Frankfurt to New York is very likely to live near Frankfurt. The difference between the passenger in Bremen and the one in Frankfurt is that the passenger in Bremen must make a stopover anyway. It would also be possible to fly Bremen-Paris-New York with Air France. The passenger in Frankfurt could also choose to fly Frankfurt-Paris-New York with Air France, however this would result in an additional stopover in Paris, whereas Lufthansa offered the direct service from Frankfurt. An airline has the incentive to lower prices for connecting flights and to charge the passenger at the hub a premium, because these passengers are locked-in at the hub. This is especially relevant for business passengers who are very time sensitive and not much inclined to take connecting services to their final destination if they do not have to. This is why it is sometimes cheaper to take a connecting flight rather than a direct flight although the direct flight should intuitively be cheaper, because it does not include an additional flight into the hub. The fact that flights out of the hub are more expensive than other flights is also known as hub premium. It has been studied and confirmed in many publications such as Berry et al (1996), Borenstein (1989) and Lijesen et al (2001). The hub premium can be the result of many different factors, such as dominance at the airport, provision of superior services (e.g. direct flights) and traffic densities. A part of the hub premium is undeniably also due to the fact that airlines can charge passengers located at the respective home hub a premium and can offer discounts for connecting services. That is in fact an example of spatial price discrimination. To find out whether airlines actually overprice their direct connections over connecting services an empirical investigation has been carried out and is presented in the subsequent sections.

4.2 Data

To find empirical evidence for the fact that connecting services are indeed cheaper than direct services an empirical investigation has been conducted. Three major European hub-and-spoke airlines (British Airways, BA; Lufthansa, LH; Air France-KLM, AF) and two long-haul (New York, JFK and Peking, PEK) and one medium-haul (Moscow, MOW[7]) destinations have been chosen to build the background of the investigation. For each of these destinations, price data was collected for direct flights out of the airlines' respective main hubs, namely London Heathrow airport (LHR) for BA, Frankfurt airport (FRA) for LH and Paris Charles de Gaulle airport (CDG) for AF. There were sometimes other airports one could have booked direct flights from, e.g. BA offered direct services to some of the destinations from London Gatwick airport. Those connections however were ignored in this study. The price data was collected over a period of two months starting from the end of February 2009. Only offered online prices for economy class tickets from the airlines' main websites were collected. To account for temporal price discrimination booking requests were made for one, three and six weeks in advance. Although it was not specifically tested for, temporal price discrimination did not seem to be much of an issue for the chosen destinations. Data was collected twice a week, on a weekday and once during the weekend. Furthermore, data was collected from

[7] Moscow has two main airports, Moscow Domodedovo (DME) and Moscow Sheremetyevo (SVO). BA and LH fly to DME, AF to SVO. To avoid confusion and because that aspect is not the focus of this paper, Moscow airports are simply referred to as MOW.

alternating computers and different persons so that the reservation systems could not easily track IP addresses. The data however was consistent across the different persons and computers. Return flights have not been investigated, only one-way flights. Including them would have resulted in such a complexity that leaving return flights out seemed as bad as putting them in. Additional questions, demanding answers, would have cropped up such as whether the return flight was on the same day/ weekday, whether a weekend stay would be involved or whether there is a five, seven or a ten day return trip. All of these potentially affect the offered price. Thus, taking one-way fares was the least complicated choice. After having collected the price information for the direct flights out of the respective home hubs, price data was collected for connecting flights via the respective main hubs. First, prices for flights out of the other two competing main hubs were collected and subsequently prices for connecting flights from Bremen (BRE)[8], Lyon (LYS) and Manchester (MAN). These cities were chosen because they are of roughly comparable size and have roughly the same distances to the respective home hub. BRE was the reference city for connecting flights for LH, LYS for AF and MAN for BA. Furthermore Milan airport (MXP) was chosen as an origin for connecting flights. It served as a reference because it is not located in any of the respective home countries of any of the three airlines. That way there were six connecting flights and one direct flight for each final destination and airline, thus resulting in a total of 3,024 observations.[9] When booking connecting flights, attention was always paid to the flight numbers. If for example the direct flight FRA-JFK had flight number LH400, it was made sure that the connecting flight via FRA also carried the flight number LH400 on the leg FRA-JFK. By this means prices between direct and connecting flights to the same destinations could be compared, because it could have been that some other connections, e.g. a flight in the afternoon, were cheaper than the direct flight which was chosen the step before.

4.3 Results

Table 1 below shows the results of the empirical investigation. Only averaged results for the three airlines (average of all three destinations for each airline) and the three destinations (average of all three airlines for each destination) are shown in an aggregated manner, i.e. the price data of all connecting flights e.g. BRE, LYS … via FRA, CDG … to PEK …) was also averaged. The individual results are also interesting (see Table 2), but the focus of the empirical investigation was to find out whether the airlines consistently overprice direct services over connecting services. The first row shows the average prices for flights out of the airlines' respective home hubs (e.g. FRA for LH or LHR for BA). The second row shows the average price for flights out the airlines' home countries. For LH for example that is the connection BRE to JFK via FRA, for AF it would be connection LYS to JFK via CDG. The third row is for flights originating from any destination that is not in the respective home carrier's country. So for LH that could be for example the connection LHR to JFK via FRA, or LYS to MOW via FRA. Conversely for BA, it included connections like MXP to PEK via LHR or FRA to JFK via LHR.

[8] BA is the only airline that does not operate from BRE. Instead prices were collected for flights out of Hamburg airport (HAM). HAM is not too far away from BRE and the price data turned out to be consistent with the prices of the other airline. Thus, it did not seem to be a big problem to choose BRE and to allow for the little inconsistency. Hamburg seemed too big a city to take this as a reference destination in the empirical investigation.

[9] Twice a week over 8 weeks, for 3 different booking periods and 7 origins to 3 destinations by 3 carriers.

Table 1 Averaged airline price data for JFK, MOW and PEK

		LH	AF	BA
Direct flights from respective main hub (e.g.: FRA-JFK with LH)	**JFK**	2,845.97 €	2,715.51 €	638.27 €
	MOW	1,119.59 €	1,368.50 €	641.49 €
	PEK	2,024.11 €	3,976.75 €	1,100.15 €
Connecting flight departing in home country with home carrier (e.g.: LYS-CDG-MOW with AF)	**JFK**	2,877.10 €	2,740.38 €	734.88 €
	MOW	1,196.20 €	1,406.65 €	740.17 €
	PEK	2,048.69 €	4,007.37 €	1,137.72 €
Connecting flight departing in country outside of home carrier (e.g.: FRA-LHR-PEK with BA or BRE-CDG-JFK with AF)	**JFK**	1,664.32 €	1,717.16 €	1,545.15 €
	MOW	1,234.09 €	1,242.02 €	745.86 €
	PEK	1,492.36 €	1,540.42 €	2,242.41 €

The data show that LH and AF strongly differentiate prices for direct services and connecting flights (i.e. connecting flights are more expensive) whereas BA's direct flights are, on average, cheaper than connecting flights. Based on the three chosen destinations, it costs over one thousand Euros more to fly with AF out of France than from any other country. It can also be seen that connecting services are not necessarily cheaper for all destinations. For MOW, there does not seem to be a large degree of spatial price discrimination, perhaps because it is a more medium-haul destination compared to PEK or JFK. It can also be seen that it is not just prices for direct services that are more expensive. Flights originating from an airline's home country (whether that includes a connecting flight or not) are also more expensive than connecting services from a foreign country. This suggests that airlines do not just enjoy a hub premium but also a country premium. At least that is the case for LH and AF. Theoretically, price competition should have pushed down prices in the second row of the above table (i.e. prices for connecting services originating in the home country should already be cheap). Instead, the second row nearly mirrors the first and prices for direct flights are almost as expensive as connecting flights originating in the home carrier's country. In the third row, spatial price discrimination can be seen since the airlines have lowered prices for origins beyond its home country's borders.

Table 2 Detailed results for all origins, destinations and airlines

		FRA	CDG	LHR	BRE	LYS	MAN	MXP
JFK	LH	*2,845,97 €*	2,663.82 €	929.41 €	2,877.10 €	2,660.40 €	761.52 €	**1,306.47 €**
	AF	2,368.64 €	*2,715,51 €*	881.10 €	2,354.74 €	2,740.38 €	914.36 €	2,066.95 €
	BA	**2,073.21 €**	**1,078.46 €**	***638.27 €***	**2,107.49 €**	**1,097.31 €**	**734.88 €**	1,369.28 €
MOW	LH	*1,119.59 €*	1,229.90 €	1,248.76 €	1,196.20 €	1,270.57 €	1,278.12 €	1,143.11 €
	AF	959.85 €	*1,368.50 €*	1,485.73 €	974.83 €	1,406.65 €	1,576.40 €	1,213.29 €
	BA	**723.65 €**	**745.79 €**	***641.49 €***	**738.69 €**	**773.10 €**	**740.17 €**	**748.06 €**
PEK	LH	*2,024.11 €*	2,138.72 €	**733.85 €**	2,048.69 €	2,136.23 €	**726.61 €**	1,726.41 €
	AF	**1,666.94 €**	*3,976.75 €*	815.97 €	**1,692.87 €**	4,007.37 €	807.43 €	2,718.87 €
	BA	3,452.00 €	**1,333.58 €**	*1,100.15 €*	3,472.36 €	**1,270.00 €**	1,137.72 €	**1,671.19 €**

(Values per origin-destination (O&D) pair are averages over data collection period, cheapest airline per O&D pair in bold, direct flights in italics)

A deeper look at the detailed data of Table 2 reveals that for JFK and MOW, BA offers the lowest fares for all origins except MXP. BA especially competes with AF in terms of its pricing decision. For example, flights with BA to JFK are considerably cheaper from French origins than from German origins. The same is true for flights to PEK. For JFK and PEK there are very cheap fares for flights out of LHR and MAN, irrespective of the airline. BA and LH offer the lowest prices for flights out of MXP to JFK and PEK (compared to AF). BA is in fact a good example for showing that spatial price discrimination must not generally mean cheaper connecting flights compared to direct flights. For reasons to be explained in the next section, direct flights from LHR are already fairly low. If prices for connecting services of competing airlines at other origins (say for example connecting flights with LH and AF from BRE to JFK) are higher than the direct flight from LHR, BA simply needs to undercut these prices by a small amount. Thus, BA's pricing behavior can also be interpreted as spatial price discrimination.

4.4 Interpretations

The empirical investigation suggests that direct flights can indeed be more expensive than connecting flights. Rather than "just" a hub premium, the results give reason to speculate that there is in fact also a country premium, because not just flights out of the home hubs, but also out of the carriers' home country were more expensive than connecting flights from abroad. A more detailed analysis might have picked up further reasons for these discrepancies and could have quantified the effects in more detail. Again, the focus of the empirical investigation in this paper was to find prima facie evidence that airlines overprice direct over connecting flights. This section discusses some factors that might have an influence on such a pricing behavior.

One reason for the pricing is one that this paper set out to investigate – spatial price discrimination. If a passenger books a connecting flight, the airline knows that the passenger is not living near the carrier's hub. Therefore, the airline knows that this passenger could have a choice of other airlines and is hence inclined to offer lower prices for this passenger, compared to the prices it offers someone who books the same flight directly out of the main hub. That way the airline is able to price

differentiate and increase its profits. Because of the "full and sequential use of flight coupon"-rule[10] arbitrage is made infeasible. While other ticket conditions, such as discounts for return flights or minimum stay rules might be avoidable (cf. Bischoff et al, 2009), this one is not except if the passenger has not checked in any baggage. For example, the passenger could book a flight from A via B to C with the intention to leave at B. Without any checked baggage such a strategy would be possible. Otherwise one has to be creative to retrieve the baggage from the airline, which they might deny with reference to the "full and sequential use of flight coupon"-rule.

As shown in section 3.2 the situations gets a little more complicated if several spatial competitors price discriminate. Although the demand for the individual airline might become more unpredictable, the airlines potentially gain from spatial price discrimination. The airlines have an incentive to conduct spatial price discrimination because this allows them to achieve higher profits. Benefits for the passengers are even more complicated. The question of whether, for example, the "full and sequential use of flight coupon"-rule is for positive for consumer or total welfare could be assessed within the framework of spatial models such as the ones detailed in the previous sections. More sophisticated and comprehensive models do not reach clear results on this topic as the papers by Holahan (1975) and Hwang & Mai (1990) show. The former concludes that spatial price discrimination leads to greater welfare than uniform pricing, whereas the latter states that the effect is ambiguous (i.e. welfare could be greater or less under spatial price discrimination) and is dependent on demand and production parameters.

So far the argumentation suggested that airlines willingly and knowingly enforce spatial price discrimination. That however must not necessarily be the case. Airlines might do what – from an economist's point of view – looks like spatial price discrimination, although they possibly would not call it that way. For example, the exact travel distance of the passenger might not be the basis for price discrimination. One obvious reason to charge lower prices for indirect connections is to achieve higher load factors on the long-haul operations. Airlines such as LH or BA operate large hub-and-spoke networks. Therefore, they have frequent flights into the hub from all the spokes they serve and outbound flights to their overseas destinations. In order to achieve high traffic densities on both the feeder flights and the long-haul flights, airlines have a natural tendency to charge lower prices for connecting services. Another reason for low prices for connecting services is competition. Since all airlines are principally able to lure passengers into their hubs by matching competitor's prices for connecting services, competition for transferring passengers is high. Competition for example is very tough in London, and indeed lowest prices were found for flights out of LHR, whether there were direct flights with BA or any other combination with the other two airlines. Competition, however, would explain low prices for all non-hub origin airports.[11] The empirical results however suggested a country premium. For once, that might be because long-haul destinations had been picked. For example, the leg BRE-FRA is tiny compared to the leg FRA-JFK. For more medium-haul destinations the situation might look different and the fact that no significant spatial price discrimination was found for MOW underlines this fact. Another factor that influences prices for direct and connecting flights is the higher willingness to pay for direct services that can be attributed to the fact that

[10] This rule is part of the small print for most airline tickets purchased. It states that passengers must take their flights in the exact order printed on the ticket. For example, if a passenger booked a flight from BRE via FRA to JFK, it is not possible to check-in at Frankfurt and leave the leg BRE-FRA unused. The passenger must use the flight coupon "full[y] and sequential[ly]". Currently the legitimacy of this rule is under judicial review (see Bischoff et al, 2009).

[11] The same low prices at LHR were also found at MAN, for example.

passengers, especially business travelers, place a high premium on time. Furthermore, there could be something like a home bias, or patriotic loyalty to the home carrier. If, for example, Germans have a strong preference to fly with LH and with no other airline no matter what, LH can cash in on that loyalty. In order to overcome that home loyalty other carriers need to offer very low prices for any abroad spoke they operate. Based on the empirical results the French seem to be the most 'patriotic', and the British the least.

5. Conclusions

This paper intended to answer the question of whether airlines engage in spatial price discrimination. Typically one would not expect airline pricing to be an example of spatial price discrimination, because the passenger's location is usually not a determining variable in the airline's price offerings. However, whenever passengers need to take a connecting flight they reveal something about their location which the airline could potentially use for price discrimination. Hence, they could offer lower prices for connecting passengers and higher prices for passengers who fly directly out of the hub. The first two sections of this paper introduced the theoretical background of spatial price discrimination under monopoly and duopoly. The model suggested that firms have an incentive to conduct spatial price discrimination. The fourth section presented the empirical investigation. It showed that airlines indeed offer lower prices for connecting services, but it also showed that this is not the case across all destinations and across all airlines. Moreover, it showed that if spatial price discrimination was present it would not only be the flights out of the hub that are more expensive, but also the flights out of the airline's home country suggesting that there is a country premium instead or in addition to a hub premium. Whether the airlines enforce spatial price discrimination willingly and knowingly and whether the distance to the hub is indeed a determining variable for the airlines' pricing decisions cannot be answered in the context of this paper. The investigation revealed that some airlines offer lower prices for connecting services compared to direct services. This is an example of spatial price discrimination, whether the airline do this for that specific reason or not. Any policy recommendation regarding this pricing behavior should take into account that the welfare effects must be taken with a pinch of salt. Airline pricing is not just an example of price discrimination under competition. Due to the fact that this is spatial price competition, extra care must be taken when developing models that intend to show welfare effects. The theoretical models presented in this paper only served to introduce the basic concepts of spatial price discrimination and showed that from the producer side there is an incentive to engage in spatial price discrimination. More sophisticated models are certainly needed to assess the welfare effects of spatial price discrimination in airline markets. Furthermore, the data set in this study was certainly limited and a more comprehensive data set is undoubtedly desirable to find out about the true extent of this pricing behavior also across continents and to account for exogenous variables, such as competition. Thus, a more detailed econometric analysis of the underlying factors and variables is a point for further research.

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