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## **Dynamic price competition in air transport market, An analysis on long-haul routes**

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We study airline price competition on long-haul markets. Our analysis includes the two main determinants of airline pricing strategies: average level of price and price dispersion. This joint analysis is particularly relevant on mature market where airlines face an increasing competitive pressure from incumbents and potential entrants. To lower price competition, they tend to differentiate their products and use complex discriminatory practices on the basis of their Revenue Management process. The price level and dispersion are jointly affected by a number of common factors. The level of competition and the date of booking compared to the day to departure appear to have a particular relevance. It's much noticing that in the airline Revenue Management process these two elements are taken into consideration. Much of the models developed in the empirical literature use the information freely provided by the US DB1B database. This restricts the empirical analysis to the US market, but most obviously the restriction lies in the quarterly nature of the data. The day of purchase is not observed and the data are quarterly aggregated.

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We use a new database where we observe all the information related to each purchased ticket for the different airlines operating on several long-haul routes. In particular the information related to the date of booking, the corresponding price and the day of departure of the flight are available in our dataset. This wealth of information opens a large scope of research. We focus first on the analysis of the impact of competition on price level and dispersion, estimating a system of equations, one standing for the level of price and the other for the price dispersion.

Airlines base their pricing policy on Revenue Management (RM) processes. Many European airlines use the RMsSystem provided by Amadeus. Its optimization process uses historical data of the company to maximise the revenue on each flight. It results in opening or closing classes during the life time of the flight booking, taking into account the load factor and the level of demand. During this optimization process the competitive pressure from airlines operating on the same route is never addressed. To consider competitive pressure, RM pricers observe daily prices of competitors and adjust the pricing of their company accordingly. The competition between revenue managers is studied in Dupuis, Ivaldi and Pouyet (Working Paper, January 2015). They analyse with a theoretical model the welfare impact of RM on profits and customers surplus. They show that customers globally benefit from revenue management as it increases the number of sales. The results are based on simulated data to address the lack of relevant data.

The daily adaptive behaviour of pricers in the revenue management process should lead to a sound homogenisation of airline pricing strategies due to competition on the market. This observation is contradictory with Netessine and Shumsky (2004) and Lua (2006) suggestions: airlines should differentiate their strategies in order to maximize their revenue on a flight. . The convergence of the average prices is confirmed in our dataset where we observe the evolution of daily prices during the life time of a flight. The empirical literature is focused on the two main characteristics of pricing strategies: The trend and the variability of prices. For instance Piga & Bachis (2006) test the common belief that LCC's fares increase monotonically over time, peaking a few days before departure Using data

from European LCC websites and online travel agents, They show that this monotonic property does not hold everywhere.

Since the seminal paper of Borenstein and Rose (1994), airline price dispersion is analysed in the empirical economic literature as a measure of price discrimination. Economic theory states that price discrimination cannot be sustained in competitive markets. However it's worth noticing that on mature markets where airlines strongly compete to keep their market shares and remain competitive, price discrimination is a common practice. Some of the empirical studies related to air transport market show that airlines price discriminate when they are in a monopoly situation (Gale and Holmes, 1993). Other empirical studies conclude however that airlines practice price discrimination even though they have limited monopoly market power (Dana 1998). In Stavins (2001), market concentration leads to a reduction in discount granted to tickets with restrictions, when those restrictions are used as discriminatory tools. The theory related to price discrimination is then controversial in air transport markets: price discrimination does not necessarily decrease as markets become more competitive.

The most contradictory results are found in Borenstein-Rose (1994) and Girardin-Shapiro (2009). Using 1989 cross section data from the usual US DB1B database, Borenstein-Rose (1994) show that price dispersion depends on the structure of the market under consideration. But given the structure of the market, price dispersion increases on route with more competition. Girardin-Shapiro (2009) obtain the opposite result: competition has a negative impact on dispersion. They use panel data from the same US DB1B database on the period 1993-2006. They justify the difference in results with the previous study by the use of panel data rather than cross-sectional data. They argue that the use of panel data allows considering potential changes in market structure and then avoiding omitted-variable bias.

The literature related to airline pricing focus not only on price dispersion but also on price level. In both cases the explanatory variables controlling for variability are the same: demand characteristics such as population or average income; customers type, such as share of business passengers; route characteristics, such as distance or market structure; carrier characteristics, such as type of airline or dominance on airport; etc. The impact of competition is measured thanks to HHI,

number of competitors, some LCC indicators of performance. The observation of price booking evolution shows a clear dependence between price dispersion, price level, but also day to departure. Mantin-Koo (2010) use online travel websites to collect price data for different dates before departure. They show that price dispersion increases with the level of airfare and that this effect intensifies as the day to departure approaches.

More recently, Ivaldi, Petrova and Urdanoz (January 2015 Discussion paper) jointly estimate the level of price and its dispersion, to account for the influence of one on each other. They suggest that airlines bid simultaneously their prices on different periods of time in a repeated game. At each period, customers choose the lowest price. The objective is to test the differences in competitive pressure for markets whether or not operating airlines belong to the same alliance. They find that if airlines competing on the same market belong to the same alliance, price dispersion is highest. This is consistent with economic theory statement: less competition leads to more price discrimination. The empirical analysis is based on US DB1B data. Their results are then constrained by the lack of information related to the day of booking.

Our dataset presents four airlines competing in several long-haul routes. Among them one is a LCC, the three others are Majors. The price evolution during the life time of the flight highlights a number of stylized facts.

First, Majors' average price curves exhibit the same general trend: starting from different levels, the average prices first decrease and seem to converge up to 50-60 days to departure. Then prices increase up to the day to departure. As expected, LCC average price is on average lower than its competitors' and remains constant during the life time of the flight. Second, price dispersion decreases with the day to departure, meaning that discrimination is decreasing as the day of departure approaches.

Our preliminary analysis is based on the assumption that firms daily compete in prices, observing the levels of all the prices on the market during the previous periods. We estimate first the direct effect of competition on the daily prices supplied by a selected airline. We focus our analysis on economic tickets. We control for the route, the airline and the day of departure. These variables have a significant impact on the level of prices. In particular the presence of the LCC

drives prices down. This result is consistent with Mantin-Koo (2010) results. We find a negative statistically significant dependence between the booking date and the price level. Finally, the prices supplied on the same routes by competitors in the previous days are statistically significant and can have a positive or negative effect depending on the carrier. This confirms RM analysts' behaviour, although the sense of competitors' price effect depends on the competitor. Thus our results are not perfectly opposite to Netessine and Shumsky (2004) and Lua (2006) findings.

The next step of our analysis will consist in using a system of price equations, each of them corresponding to an airline, to better identify and assess the interactions between airlines. In particular we will study the behavioural strategies (Stackelberg competition, collusion...) leading to a price convergence among majors. This could be explained either by an increase in competitive pressure as we approach the departure date. In this case the presence of a LCC on the market might have a non-negligible impact. Also, this could reflect a decrease in customer's price sensitivity as the day to departure approaches and the expectation of remaining capacities also decreases. Here we will have to distinguish these different impacts, to analyse which part of the sensitivity is due to pure price discrimination. We will also consider jointly price level and dispersion. Thus the global system of competition in price on the markets under consideration will be analysed.