PRICE DISCRIMINATION IN THE AIRLINE MARKET: THE EFFECT OF MARKET CONCENTRATION

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Abstract—We test the hypothesis that price discrimination increases with competition in the airline market. Using a large cross section of tickets offered by several carriers on various routes, we approximate price discrimination with marginal implicit prices of ticket restrictions that carriers typically use to price discriminate: Saturday-night stayover requirements and advanced-purchase discounts. We find that the restrictions are associated with lower airfares, but that the discounts are smaller on routes with higher market concentration. The results suggest that price dispersion attributed to ticket restrictions increases as markets become more competitive.

I. Introduction

THEORETICAL literature shows that price discrimination may increase as the market becomes more competitive.[1] Two theoretical studies have addressed the connection between price discrimination and market concentration in the airline market: Dana (1998) showed that price discrimination by air carriers could be observed even if market concentration is low and a carrier has no market power, and Gale and Holmes (1993) showed that, under certain conditions, a monopoly airline will offer tickets with restrictions to "weed out" consumers with high valuation of time.

Both studies pointed out that air carriers use advance-purchase discounts and Saturday-night stayover requirements to price discriminate. However, no empirical studies have used ticket restrictions to estimate the effect of market concentration on price discrimination. We estimate marginal effects of individual ticket restrictions on airfares and compare the effects across routes with various levels of market concentration. As always in such models, it is difficult to distinguish between cost-based and demand-based price dispersion. However, calculating differences in marginal effects of ticket restrictions across routes with different levels of market concentration facilitates isolation of demand-side factors.

Empirical studies of the airline market show that, as market concentration increases, so does the average price level (Borenstein, 1992, Morrison & Winston, 1990). Borenstein and Rose (1994), in the seminal paper on price dispersion in the airline market, found a negative effect of market concentration on price dispersion. Price discrimination, however, indicates different prices or price markups charged to customers with equal costs. Airlines price discriminate among their customers by attaching certain ticket restrictions to cheaper tickets, thus making them unattractive to consumers with higher valuations of time and convenience. Morrison and Winston (1995) showed changes in the effect of competition on fare dispersion over time, but did not separate cost effects from price discrimination effects.

We estimate marginal effects of ticket restrictions on airfare, after controlling for cost-based factors and carrier effects. The ticket restrictions we consider—Saturday-night stayover requirements and advance-purchase discounts—are the ones used by airlines to separate consumers based on their valuation of convenience and flexibility. As Dana (1998) showed, carriers use those restrictions to screen consumers when their demand is heterogeneous and uncertain. Although even those restrictions have some effect on air carriers' costs,[2] they constitute major discriminatory tools used by airlines. Moreover, the main purpose of this paper is to estimate the difference in the marginal effect of the restrictions across markets with various concentration levels. To the extent that the cost effects do not vary with market concentration, our estimates provide good approximations for the true differences. We find that both restrictions are associated with lower fares, but that the discount decreases somewhat with market concentration. In other words, when carriers face higher competition, they increase the discounts offered in exchange for the restrictions.

Section II describes the data. Section III presents the model, and Section IV discusses the estimation results. Section V offers conclusions.

II. Data

This study uses data collected from the electronic version of the *Official Airline Guide*. The data include information on 5,804 tickets offered for flights on twelve routes on the same day: Thursday, September 28, 1995. This date was picked to avoid summer or holiday peaks, as well as weekend travel. (Selecting a single day eliminates price differences due to travel on different days of the week.) All flights on that day on the selected routes were included in the sample. Each ticket is a price-characteristic combination, and the data include fares offered for sale at various times before the scheduled travel data. A variable was constructed to control for the number of days prior to departure that the fare was offered.

Although the data set is fairly large, it includes a relatively small number of routes, and thus the variance in market concentration is low. Because the observations collected on the twelve routes are used here to identify coefficients on eight route-level coefficients, the results should be treated with caution. To test for robustness, we use two different ticket restrictions in the estimation. Both yield the same qualitative results.

The data include four different restrictions that could be attached to each fare: a cancellation penalty, the number of days in advance that purchase is required, whether or not a Saturday-night stayover is required, and other (unspecified). The restrictions were highly correlated. To avoid multicollinearity, one restriction at a time was included in the estimation. Following Dana (1998) and Gale and Holmes (1993), the Saturday-night stayover requirement and the number of days of advance-purchase requirement were used as proxies for price discrimination. The requirement to stay over Saturday night is least likely to be correlated with cost effects.

Previous studies have found that using either the number of flights or the number of passengers on a route as a basis for market concentration calculations yields similar results.[3] Because the data do not include the number of passengers, the number of flights on each

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[1] Borenstein (1985), Holmes (1989), and Gale (1993). For example, in Gale's theoretical model, there is more price discrimination under duopoly than under monopoly.

[2] For example, advance-purchase discounts can increase load factors (Borenstein & Rose, 1994; Morrison & Winston, 1995).

[3] See Bailey, Graham, and Kaplan (1985), Borenstein (1991), and Borenstein and Rose (1994).

route was used to calculate each carrier's market share and the Herfindahl-Hirschman index (*HHI*) on each route. As an alternative measure, the number of carriers on a given route was also used.[4]

III. Model

The model is a reduced-form regression of airfare on ticket restrictions, market concentration on the route, the carrier's market share, and other route- and ticket-specific factors. We estimate two equations: the first equation has no restriction-concentration interaction, and the second equation allows for a separate effect of the restriction-concentration interaction on airfares.

$$\begin{aligned}\ln P_{ijk} = {} & \beta_0 + \beta_1 R_{ijk} + \beta_2 HHI_i + \beta_3 S_{ij} + \beta_4 DIST_i \\ & + \beta_5 DISTSQ_i + \beta_6 AVGPOP_i + \beta_7 AVGINC_i \\ & + \beta_8 TEMP_i + \beta_9 HUB_{ij} + \beta_{10} SLOTS_i \\ & + \beta_{11} ONEWAY_{ijk} + \beta_{12} DIRECT_{ij} + \beta_{13} FIRST_{ijk} \\ & + \beta_{14} DAYS_{ijk} + \epsilon_{ijk}\end{aligned} \tag{1}$$

where P is the round-trip airfare,

R is a ticket restriction,
HHI is the Herfindahl index,
S is the carrier's market share,
DIST and *DISTSQ* are the distance between the two endpoints and distance squared, respectively,
AVGPOP is the average population and *AVGINC* the average per capita income in the two metropolitan areas,
TEMP is the absolute difference in mean January temperatures between the origin and destination,
HUB is a dummy variable equal to 1 if the carrier has a hub in the origin or destination,
SLOTS is a dummy variable equal to 1 if the number of takeoff and landing slots at either airport is regulated,[5]
ONEWAY is a dummy variable equal to 1 for one-way tickets,
DIRECT is a dummy variable equal to 1 for direct flights,
FIRST is a dummy variable equal to 1 for first-class tickets,
DAYS indicates the number of days prior to departure that the fare was last offered,
subscript i denotes route,
subscript j a carrier, and
subscript k a particular ticket for the carrier on the route.

Ticket restrictions are expected to have a negative effect on airfare, and market share to have a positive effect.

We measure price discrimination as the partial effect of ticket restrictions on price. In equation (1), price discrimination is assumed not to vary with market concentration. Equation (2) allows for price discrimination to vary with market concentration:

[4] Some studies have used the number of potential competitors on the route. However, Borenstein (1992) and Hurdle et al. (1989) showed that the number of potential competitors has a much smaller effect on ticket prices than does the number of carriers actually operating on a given route. Borenstein (1989) also found the route market share to be a better predictor of ticket price than the airport market share.

[5] Destination airports with a regulated number of takeoff and landing slots are Chicago O'Hare, Washington National, John F. Kennedy, and La Guardia.

TABLE 1.—NO-INTERACTION MODELS: (1) WITH THE SATURDAY-NIGHT STAYOVER REQUIREMENT AND (2) WITH ADVANCED-PURCHASE DISCOUNTS

	(1)		(2)	
	Coefficient	*t*-statistic*	Coefficient	*t*-statistic*
Intercept	4.601	27.26	4.497	27.42
Saturday-night stayover requirement	−0.249	−2.50	—	—
Advance-purchase requirement	—	—	−0.007	−2.16
HHI	−0.444	−2.10	−0.361	−1.71
Market share	0.326	3.00	0.250	2.29
Distance	0.001	18.54	0.001	18.11
Distance squared	$-2.78e^{-7}$	−13.91	$-2.73e^{-7}$	−13.65
Average population	0.00008	13.15	0.00008	13.58
Average per capita income	0.00003	4.87	0.00003	5.38
January temperature	0.0002	0.37	0.0006	1.23
Hub dummy	−0.020	−1.40	−0.025	−1.80
Slots dummy	−0.510	−16.42	−0.505	−16.76
One way	0.926	27.66	0.983	41.11
Direct	−0.014	−1.33	−0.015	−1.47
First class	0.533	42.18	0.537	42.87
Number of days prior to departure	−0.0007	−1.43	−0.0006	−1.32
N	5804		5804	
R^2	0.776		0.775	
F	952.76		961.57	

* *t*-statistics are based on robust standard errors.

$$\begin{aligned}\ln P_{ijk} = {} & \alpha_0 + R_{ijk}(\gamma_0 + \gamma_1 HHI_i) + \alpha_1 HHI_i + \alpha_2 S_{ij} + \alpha_3 DIST_i \\ & + \alpha_4 DISTSQ_i + \alpha_5 AVGPOP_i + \alpha_6 AVGINC_i \\ & + \alpha_7 TEMP_i + \alpha_8 HUB_{ij} + \alpha_9 SLOTS_i \\ & + \alpha_{10} ONEWAY_{ijk} + \alpha_{11} DIRECT_{ij} + \alpha_{12} FIRST_{ijk} \\ & + \alpha_{13} DAYS_{ijk} + \nu_{ijk}\end{aligned} \tag{2}$$

The variables are defined as before. Based on equation (2), price discrimination is estimated as

$$\frac{\partial P}{\partial R} = (\gamma_0 + \gamma_1 HHI)\, P \tag{3}$$

IV. Results

Equation (1) was estimated with airline fixed effects and robust standard errors. Fixed effects control for carrier-specific characteristics. Following Graham, Kaplan, and Sibley (1983), *HHI* is assumed to be exogenous in airfare estimation. Table 1 presents the results with the Saturday-night stayover requirement (column 1) and the advance-purchase requirement (column 2). The effect of a ticket restriction on price (price discrimination) was negative and significant, whether the Saturday-night stayover or the advance-purchase requirement was used. Evaluated at the median price, adding a Saturday-night stayover requirement resulted in a $211.17 drop in the ticket price. Increasing the advance-purchase requirement by a day resulted in a $6.04 decrease in the ticket price. Thus, a ticket with a fourteen-day advance purchase requirement cost $84.56 less than a similar ticket on the same route without the requirement.

Because fares were offered at various times prior to departure, the data allow for examination of how prices change as the departure date nears. As the date of ticket offer gets closer to the departure date, cheaper fares disappear, leaving only more-expensive tickets for sale.

TABLE 2.—INTERACTION MODELS: (1) WITH THE SATURDAY-NIGHT STAYOVER REQUIREMENT AND (2) WITH ADVANCED-PURCHASE DISCOUNTS

	(1)		(2)	
	Coefficient	*t*-statistic*	Coefficient	*t*-statistic*
Intercept	4.583	27.94	4.487	28.31
Saturday-night stayover requirement	−0.408	−4.05	—	—
Saturday stayover × *HHI*	0.792	3.39	—	—
Advance-purchase requirement	—	—	−0.023	−5.53
Advance-purchase × *HHI*	—	—	0.098	8.38
HHI	−0.656	−3.22	−0.621	−2.93
Market share	0.313	2.89	0.235	2.16
Distance	0.001	19.00	0.001	18.62
Distance squared	$-2.80e^{-7}$	−14.36	$-2.72e^{-7}$	−14.06
Average population	0.00008	13.60	0.00008	13.92
Average per capita Income	0.00003	5.42	0.00003	5.98
January temperature	−0.0002	0.48	0.0005	0.94
Hub dummy	−0.020	−1.4	−0.022	−1.58
Slots dummy	−0.517	16.72	−0.505	−16.91
One way	0.927	27.75	0.981	41.32
Direct	−0.014	−1.34	−0.016	−1.55
First class	0.533	42.36	0.536	43.10
Number of days prior to departure	−0.0007	−1.44	−0.0006	−1.28
N	5804		5804	
R^2	0.776		0.776	
F	922.62		968.39	

* *t*-statistics are based on robust standard errors.

Indeed, the coefficient on the number of days prior to departure variable was negative in all specifications.

Equation (2) was also estimated with fixed carrier effects and robust standard errors. The results of the regression with the Saturday-night stayover requirement are shown in column 1 of table 2. The estimated price discrimination is

$$\frac{\partial P}{\partial Sat} = (-0.408 + 0.792HHI)\,P \tag{4}$$

We calculated the partial effect of a Saturday-night stayover requirement on airfare at various level of *HHI*. The higher the market concentration on a route, the lower the effect of the restriction on airfare. The estimated price discounts at the 25th, 50th, and 75th percentiles of *HHI* were $253, $233, and $165, respectively.

In the case of an advance-purchase requirement (column 2 of table 2), the price-discrimination effect derived from the estimated equation is

$$\frac{\partial P}{\partial Sat} = (-0.023 + 0.098HHI)\,P. \tag{5}$$

The estimated effect on airfare of imposing a fourteen-day advance-purchase requirement, calculated at the 25th, 50th, and 75th percentiles of *HHI* for the sample, were $111, $76, and $41, respectively. As above, the higher the market concentration on a route, the smaller the effect of the restriction on airfare.

V. Summary and Conclusion

Although theoretical studies have shown that price discrimination may be higher in competitive markets than in monopoly ones, few authors have tested the hypothesis. Other studies have pointed out that airlines use certain ticket restrictions to price discriminate among their customers. This paper uses marginal implicit prices of ticket restrictions as a proxy for price discrimination and compares those marginal effects across routes with various levels of market concentration to test whether airlines discriminate more on more-competitive routes.

Using a large cross section of tickets offered by several carriers on various routes, we find that price discrimination decreases with market concentration. Both Saturday-night stayover and advance-purchase requirements—the restrictions that have been recognized as price-discriminatory tools—yielded consistent results. Although tickets carrying either restriction were found to cost less, the discount was found to be lower on routes with higher market concentration. The opposite was found for carriers' market shares: airlines with higher market shares on a given route were found to price discriminate more. The results are consistent with the hypothesis that, as more carriers operate on a given route, the carriers' competition for consumers with higher price elasticity of demand increases, while fares charged to consumers with inelastic demand stay high, holding cost effects constant. As a result, price discrimination is higher on routes with more competition. The effect of market concentration was similar whether or not market share was included in the equation.

The study would benefit from more-extensive data. In particular, data should be collected on more routes to allow for greater variation in market concentration. Panel data would allow to better separate cost-based and demand-based price dispersion. The methodology developed here can easily be replicated with more-extensive data.

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