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DETERMINANTS OF PRICE DISPERSION IN U.S. AIRLINE MARKETS

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ABSTRACT

Although a well recognized and unpredicted post deregulation development, the complex airline fare structure has received relatively little research attention. This paper develops a multiple regression model measuring the relationship of several market variables to the degree of ticket price dispersion observed in the 200 largest U.S. airline markets during the third quarter of 1995. A wide range of ticket prices is evident on most routes. The results show that ticket price dispersion on some given route increases with the number of competitors, with service by a combination of non-stop and connecting flights, when a low-cost airline competes with other major carriers, and when the capacity of one of the airports is limited by regulation. The model explains 41 percent of observed ticket price dispersion.

INTRODUCTION

Two air travelers discover in casual conversation that one paid several times more for her ticket than did the other, not an uncommon experience. The great assortments of ticket prices available for a given flight, along with the perplexing purchase restrictions attached to all but the highest fares, confuse and frustrate many passengers. This paper employs a regression analysis to estimate the relationship between the degree of price dispersion on the 200 largest U.S. airline markets and several market variables. While the results generally confirm those of the seminal studies of airline price dispersion, the introduction of two new independent variables greatly increases the explanatory power of the regression.

LITERATURE REVIEW

The complexity of airline ticket prices is a major and completely unanticipated development which followed the deregulation of domestic airline industry in 1978. During 40 years of economic regulation, the Civil Aeronautics Board (CAB) approved domestic fares based on a simple,

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mileage-based formula which cross-subsidized short and low density routes from high density, long haul markets (Levine, 1987). Although rare, limited price competition gradually emerged. Capital Airlines' introduction of coach fares with high density seating and few amenities in the late 1940s was quickly matched by other carriers. In the 1950s, the San Francisco-Los Angeles market grew rapidly after regulated carriers were allowed to match the fares offered by unregulated intrastate carrier Pacific Southwest Airlines (Cross, 1995). In response to the threat of non-scheduled airlines offering low fares and Spartan service in high density markets, the CAB approved American Airlines' Super Saver fares in 1977 at discounts approaching 50 percent of the existing fare. The success of the Super Saver in attracting price sensitive passengers led to speedy approval of similar discount fares by other carriers and accelerated the process of deregulation (Petzinger, 1995). Over the next few years, American became ever more adept in segmenting business from leisure passengers, charging each a price which maximizes revenue. By the early 1980s, American successfully defended its markets against encroachment by a spate of new entrants, low-cost carriers, most notably People Express.

Ever more sophisticated software programs designed to optimize revenue, generally known as yield management systems, are now employed by every major carrier and considered essential to financial success. By continuous comparison of current reservation levels for each future flight against historical booking curves, the yield management system dynamically allocates the number of seats available at various prices (Brumelle & McGill, 1993; Harris, 1995; Smith, Leimkuhler, & Darrow, 1992).

The highly complex fare structures which have evolved from the implementation of yield management systems surprised deregulation proponents. Pointing to then existing unregulated intrastate airlines as exemplars, deregulation advocates predicted an industry characterized by high flight frequency along linear route systems with low, simple fares (Bailey, Graham, & Kaplan, 1985; Borenstein, 1992; Kahn, 1988; Levine, 1987). Rather than a simple system of peak and off-peak fares like those pioneered by former intrastate carriers such as Southwest Airlines (Petzinger, 1995), passengers face a bizarre array of fares on any given flight.

Post deregulation changes in airline marketing, route structure, concentration, and average fares have received extensive research attention. Most studies confirm an aggregate improvement in consumer welfare; however, the benefits are not uniformly distributed. Service increases and real price reductions in major markets are balanced by the opposite result in many low density routes. Hub and spoke route systems provide increased frequency but at the cost of fewer non-stop flights (see Morrison & Wintson, 1995, for a review). Although the dramatic changes in ticket price structure are well recognized, fare dispersion has attracted relatively few researchers. Evans and Kessides (1993b) present data showing the ratio of 90^{th} to 10^{th} percentile yields (ticket price per mile) increased 76 percent in the ten years following industry deregulation. Ratios of other percentiles show a similar but less striking increase. Perhaps as interesting, they also report greater range of ticket prices for established carriers than for new entrants. The established carriers charge higher prices at the 90th percentile and lower prices at the 10^{th} percentile. These data show, as Evans and Kessides and others have suggested, that established carriers effectively employ price discrimination to compete with new entrants.

Borenstein and Rose (1994), analyzing domestic airline price data from the second quarter of 1986, find expected absolute difference in fares between two passengers on a route is 36 percent of the airline's average ticket price. Consistent with models of monopolistically competitive price discrimination, competitive routes exhibit more price dispersion; however, higher market density and concentrations of tourist passengers reduce dispersion. (Borenstein, 1985; Gale, 1993; Holmes, 1989) Other results show dispersion in an airline's ticket prices on a route varies directly with average fare and carrier dominance of airport endpoints. Borenstein and Rose's multiple regression analysis accounts for less than 20 percent of the observed price variance inviting further exploration.

In a similar more recent study, Hayes and Ross (1998) find competition from premier low-cost carrier Southwest Airlines reduces route price dispersion. Unfortunately, the large number of independent variables employed in their regression yields ambiguous and conflicting results for other measures of market power, structure, and cost.

MODEL

The model regresses ticket price dispersion computed for each route between airports serving the largest two hundred U.S. airline markets. Because several cities are served by more than one airport, the sample includes 338 individual routes. The dispersion statistic is coefficient of variation (DISP), the sample standard deviation of ticket prices divided by the sample mean price. Borenstein and Rose (1994, p. 655) use a somewhat more complex measure of dispersion (Gini coefficient) but note similar results with other dispersion statistics including the coefficient of variation.

The regression equation to be estimated is:

$$DISP = B_0 + B_1 HERF + B_2 NONSTP + B_3 LOCSTtr + B_4 ALTLOCST + B_5 \sqrt{DIST} + B_6 HUB + B_7 SLOT + B_8 VAC + e.$$

The independent variable hypotheses discussed next are also summarized in Table 1.

Table 1. Summary of Regression Variables for Price Dispersion in U.S. Airline Markets

Dependent Variable	*Abbreviation*		
Ticket Price Dispersion	DISP		
Independent Variables	*Abbreviation*	*Predicted sign*	*Relationship*
Distance	$\sqrt{DIST}$	+	Square root
Concentration	HERF	-	Linear
Non-stop competition	NONSTP	+	Parabolic
Direct low-cost competition	LOCSTtr	+	Parabolic
Indirect low-cost competition	ALTLOCST	+	Linear
Hub dominance	HUB	+	Linear
Capacity controlled airport	SLOT	+	Linear
Vacation route	VAC	-	Linear

Route Concentration (HERF)

Though the industry is intensely competitive, many product attributes differentiate individual airline flights. The literature suggests: (a) the number and timing of flights in each market; (b) routing whether non-stop, direct (no change of plane), or connecting; and (c) frequent flyer programs are important attributes, particularly for business travelers. Others include airport facilities, ground and in-flight service, reputation and image, type of aircraft, and geographical dominance of computer reservation system (Abramowitz & Brown, 1993; Borenstein, 1991, 1992; Levine, 1987). Because passengers will value these attributes differently, they can be expected to display varying degrees of brand loyalty. An airline with high brand loyalty of one or more passenger segments may decide to meet competition by lowering its prices more for passenger segments with higher cross elasticity than for other segments, thus increasing ticket price dispersion. Therefore, an inverse relationship between market concentration and price dispersion is anticipated.

The Herfindahl index (HERF), a commonly employed metric in airline economic studies, was computed from the raw data as the measure of market concentration. This statistic is the sum of the squared market shares of all carriers operating on a route. For example, the Herfindahl index of a route with three carriers each capturing an equal market share is:

$$(1/3)^2 + (1/3)^2 + (1/3)^2 = 0.3333 \text{ or}$$

$$\sum_{I=11}^{N} S_i^{2}, \text{ where } S_i = \text{market share of } i^{\text{th}} \text{ carrier.}$$

Proportion of Non-stop Flights (NONSTP)

The hub and spoke route structure common to all major carriers except Southwest Airlines obliges an airline to connect most of its markets with a stop at its hub(s). Although the majority of flights to and from the hub(s) will operate non-stop, an airline can also choose to operate non-stop flights for competitive advantage in some markets.

Because passengers value the time savings and convenience of non-stop flights, carriers operating non-stop flights in competition with carriers requiring a connection should enjoy a competitive advantage reflected in higher ticket prices. Likewise, carriers offering connecting flights may have to offer lower fares to optimize revenues. Price dispersion, therefore, should be related to the proportion of passengers traveling on non-stop flights. Because this relationship has not been previously employed in the literature, peak dispersion is hypothesized to occur when competition is most intense with 50 percent of passengers traveling on non-stop flights while the remainder connect through a hub airport. The variable NONSTOP was computed equal to the sample proportion of passengers traveling non-stop minus this proportion squared. This parabolic function should be positively correlated to price dispersion.

Competition from Low-cost Airline (LOCSTtr)

Windle & Dresner (1995) and Dresner, Lin, & Windle (1996) find a substantial and sustained decrease in average ticket price with the entry of a low-cost carrier on a route. They also showed a significant, though smaller, effect from low-cost carrier operation on a competing route. Because incumbent major carriers are likely to meet such competition by lowering discount fares more than unrestricted fares, a positive correlation of competition from a low-cost carrier and price dispersion is anticipated. On the other hand, low-cost carriers, particularly Southwest, dominate many routes enjoying a monopoly on some. Because high route concentration is expected to reduce price dispersion, the overall relationship between low-cost carrier market share and price dispersion should be a parabolic function of the form: LOCST–(B)(LOCST2) where LOCST is the market share of the low-cost competitor. A preliminary regression established the coefficient B at 1.68. Final regression results employed the transformed variable LOCSTtr equal to LOCST–1.68(LOCST2).

As used in this research, a low-cost carrier is a post-deregulation interstate airline competing primarily on the basis of price. Table A1 of the Appendix lists those carriers meeting this definition in 1995.

Low-cost Competition on Competing Routes (ALTLOCST)

In some cities, low-cost carriers have not been able to obtain access to the area's major, and frequently preferred, airport, but offer competing service from a secondary airport. In Chicago, for example, O'Hare International Airport has only one low-cost carrier, but several low-cost carriers, including Southwest Airlines, operate from Midway Airport. ALTLOCST is the market share of the low cost carrier(s) on a directly competing route. Its coefficient should be positive.

Square Root of Distance ($\sqrt{\ }$DIST)

The shorter the route, the more viable are automobile and other surface transportation as substitutes for air travel. As the direct and imputed cost of the traveler's time increases with distance, however, both business and time-constrained leisure travelers find few substitutes for air travel. Surface transportation substitutes, therefore, should constrain the range of ticket prices in both the leisure and business segments on shorter distance markets with rapidly diminishing effect as distance increases. The square root of the distance in hundreds of miles is taken as the predictor variable. The coefficient of distance should be positive.

Hub Airport as an Endpoint (HUB)

Many studies show that major carrier hub dominance is related to higher average fares to and from the hub airport, a result generally attributed to a premium charged to business passengers traveling on the dominant hub carrier (Bailey & Liu, 1995; Berry, 1990; Borenstein, 1989, 1990, 1991; Brueckner, Dyer, & Spiller, 1992; Evans & Kessides, 1993a; Kahn, 1993). If the hub carrier extracts a premium business fare, ticket price dispersion should be higher on routes with a hub airport as an endpoint. HUB is a dummy variable with a value of 1 if either the origin or destination (an endpoint) is a hub airport of a major airline.

Capacity Controlled Airport (SLOT)

Due to airport congestion and air traffic control limitations, the Federal Aviation Administration allots a limited number of takeoff and landings (slots) to air carriers at four major U.S. airports: New York LaGuardia and Kennedy, Washington National, and Chicago O'Hare. To this list, Los Angeles Orange County Airport, which is similarly restricted by local government, has been added.

As would be expected, previous studies have shown higher average fares on routes to or from capacity controlled airports (Abramowitz & Brown, 1993; Morrison & Winston, 1990). These airports, however, only operate at capacity during peak demand hours, typically early morning and late afternoon. Fares for flights during these hours will be higher than at airports with excess capacity. During other hours, however, airlines can add flights to accommodate the leisure elastic demand market segments. As a result, price dispersion is expected to be positively correlated to this variable. SLOT is dummy variable with a value of 1 if either the origin or destination is a capacity controlled airport and 0 otherwise.

Vacation Destination (VAC)

Leisure passengers predominate on routes to and from vacation destinations. The low proportion of business travel on these routes limits the revenue potential of higher unrestricted fares generally purchased by business passengers. Following Windle and Dresner (1995), vacation routes are defined as those with an endpoint in Florida, Nevada, Hawaii, or Puerto Rico. The coefficient of VAC is hypothesized to be negative. VAC is a dummy variable with a value of 1 if either the origin or destination is predominately a vacation or leisure travel location.

Table A2 of the Appendix lists the origin/destination airport characteristics employed the regression.

DATA

The data are a ten percent random sample of U.S. airline domestic passenger tickets for the third quarter of 1995 drawn from the U.S. Department of Transportation's Origin and Destination Survey, Databank 1A (DOT, 1996). The data include: (a) origin, destination, and intermediate stop(s), if any; (b) airline; (c) one-way ticket price or half of round-trip fare and number of passengers traveling at each fare; and (d) total itinerary distance and direct distance between origin and destination. The database was filtered to obtain: (a) the top 200 domestic origin and destination markets but excluding airport pairs within these markets of less than ten sample passengers; (b) single carrier tickets excluding connections between airlines; (c) domestic itineraries excluding international and domestic portion of international travel; (d) coach tickets excluding first class; and (e) tickets of more than $10 excluding those of lesser amount presumed to be frequent flyer or other promotional fares.

By examination, fares for one route, Dallas Love Airport to Los Angeles International, were judged not representative of the population and excluded from the analysis because of large directional fare disparity.

RESULTS

Descriptive Statistics

Descriptive statistics, presented in Table 2, confirm Borenstein and Rose's (1994) finding of substantial ticket price dispersion. The mean of the coefficient of variation across all routes is 21 percent ranging from a high of 58 percent on the New York Kennedy to Palm Beach, Florida, route to a negligible variance on the route from Chicago's Midway Airport to Indianapolis, a Southwest Airlines monopoly. Notably, of the 20 routes with the lowest price dispersion, Southwest served all but two and enjoyed a monopoly or faced only insignificant competition (average Herfindahl index of 0.995). Twelve of these twenty routes originated from Southwest's home field, Dallas Love Airport.

The mean of the Herfindahl Index is .58 or the equivalent of 1.72 carriers serving the average route. Sixty-five of the 338 routes have a Herfindahl index of 0.9 or greater indicative of either monopoly or insignificant competition. Fifty-four routes have an index of less than 0.33 or the equivalent of three or more carriers with equal market share competing on the route. Of the eleven routes with an index of 0.2 or less, ten are routes from New York or Washington, D.C.

Just over 25 percent of all passengers traveled on low cost carriers; 142 of the 338 routes had no low cost competition. Seventeen routes were low cost carrier monopolies; low cost carriers held more than a 90 percent market share on 49 routes.

Hub, capacity controlled, and vacation airports accounted for 60 percent, 33 percent, and 23 percent of all routes respectively.

Regression Results

The results of the regression are presented in Table 3. The regression equation and four of the eight independent variables are highly significant (F = 30.64, p = 0.0000; HERF, T = -6.4, p = .0000; NONSTP, T = 3.3, p = .0011; LOCSTtr, T = 3.1, p = .0019; SLOT, T = 3.6, p = .0003). The signs of the coefficients for the significant variables are as predicted. The

Table 2. Descriptive Statistics of the Determinants of Price Dispersion in U.S. Airline Markets, 1995

Stat	*DISP*	*DIST*	*HERF*	*NONSTP*	*LOCSTtr*	*ALTLOCST*	*HUB*	*SLOT*	*VAC*
Mean	0.21523	27.4637	0.57691	0.06292	-0.0848	0.18568	0.60947	0.33136	0.22781
Std Error	0.00652	0.58249	0.01365	0.00383	0.01342	0.01932	0.02658	0.02564	0.02285
Median	0.20515	24.8293	0.50595	0.03517	0	0	1	0	0
Mode	#N/A	17.2047	1	0	0	0	1	0	0
Std Dev	0.11984	10.7089	0.25093	0.07043	0.24663	0.35526	0.48859	0.4714	0.42004
Sample Var	0.01436	114.68	0.06297	0.00496	0.06083	0.12621	0.23872	0.22222	0.17643
Kurtosis	-0.1134	-0.5731	-0.9751	8.9E-05	1.17307	0.72015	-1.8075	-1.4908	-0.3021
Skewness	0.42811	0.63244	0.47409	1.03705	-1.622	1.58113	-0.4508	0.71974	1.30373
Range	0.58041	42	0.84716	0.24989	0.82881	1	1	1	1
Minimum	0.00064	10	0.15284	0	-0.68	0	0	0	0
Maximum	0.58105	52	1	0.24989	0.14881	1	1	1	1
Sum	72.7472	9282.73	194.995	21.267	-28.658	62.7615	206	112	77
Count	338	338	338	338	338	338	338	338	338

DISP-Ticket price dispersion
DIST-Distance
HERF-Concentration
NONSTP-Non-stop competition
LOCSTtr-Direct, low-cost competition
ALTLOCST-Indirect, low-cost competition
HUB-Hub dominance
SLOT-Capacity controlled airport
VAC-Vacation route

equation explains 41 percent of the total ticket price variance(adjusted R^2 = 0.413).

The standardized beta coefficients provide a measure of the relative influence of each independent variable on ticket price dispersion. These coefficients are -.36, .23, .18, and .14 for HERF, NONSTP, LOCSCTtr, and SLOT, respectively, and show the route concentration has the greatest explanatory power.

Table 3. Regression Results of Determinants of Price Dispersion in U.S. Airline Markets, 1995

Multiple R	.64733
R Square	.41904
Adjusted R Square	.41206
Standard Error	.09189

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	4	2.02792	.50698
Residual	333	2.81155	.00844
F =	60.04655	Signif F =	.0000

——— Variables in the Equation ———

Variable	B	SE B	Beta	T	Sig T
HERF	-.172539	.024749	-.361293	-6.972	.0000
NONSTP	.390133	.075838	.229289	5.144	.0000
LOCSTtr	.090745	.024936	.184272	3.639	.0003
SLOT	.035049	.011042	.137872	3.174	.0016
(Constant)	.286105	.016630		17.204	.0000

——— Variables not in the Equation ———

Variable	Beta In	Partial	Min Toler	T	Sig T
DIST	.028528	.025163	.451974	.459	.6468
ALTLOCST	-.059301	-.074116	.649533	-1.354	.1766
HUB	.026490	.031069	.573348	.566	.5715
VAC	.046463	.059465	.623918	1.085	.2785

DISCUSSION

The inclusion in this research of market variables for low-cost carrier and non-stop flight competition add insight and explanatory power to Borenstein and Rose's seminal study of airline ticket price dispersion. Although Dresner et al. (1996) have demonstrated the powerful effect of low cost carrier competition in lowering average ticket prices, the effect on price dispersion had not been previously estimated. Likewise, the non-stop variable has not heretofore been included in the airline pricing literature. Though the results generally confirm those of Borenstein and Rose, the explanatory power of the regression equation is doubled.

Competition and Price Discrimination

Markets typically embody the ideals neither of perfect competition nor of pure monopoly but are instead imperfectly competitive lying somewhere between the two poles. Along this continuum, classic microeconomic theory suggests that price discrimination decreases with increased competition. Instead, the results confirm the theoretical work of Borenstein (1985), Holmes (1989), and Gale (1993) and Borenstein and Rose's (1994) empirical findings that price dispersion under imperfect competition increases with competition. In the research sample, the Herfindahl index of route competition is the most robust indicator of price dispersion. Airlines appear to respond to increased competition with aggressive passenger segmentation and pricing. Although ground and in-flight amenities serve to differentiate products, segmentation is primarily achieved with purchase restrictions while seat inventory is dynamically controlled by yield management systems. The theory and findings suggest a similar pattern may be found in other service industries which practice some form of yield management and may well generalize beyond the service industries.

Because the regression model does not include any measurements of marginal cost, finding substantial and widespread ticket price dispersion does not prove price discrimination. On the other hand, airline yield management systems allocate seat inventory on the basis of forecast demand without regard to cost. Price discrimination is, therefore, implied by the existence of large price dispersion for a product with only minor within-carrier attribute differences (the sample does not include tickets of first class passengers).

Product Differentiation

The regression results show that the presence of low-cost carrier competition and/or a combination of non-stop and connecting flights on a route increase price dispersion. Since both these predictor variables are product attributes, these results suggests that increased product differentiation leads to increased route price dispersion. Although neither variable was employed by Borenstein and Rose, the finding is intuitively appealing—differentiated products should sell for differing prices.

The non-stop variable (NONSTP) is a parabolic function of non-stop flight market share which peaks with an equal number of passengers traveling on non-stop and connecting flights. Carriers offering non-stop service can apparently extract a premium for superior service. Although airline marketers are certainly aware of this advantage, the premium pricing flows directly from the operation of the yield management system.

The low-cost carrier variable (LOCSTtr) is also a parabolic function which peaks at a 30 percent route market share for low-cost carriers. This finding suggests traditional incumbent carriers can sustain a price premium for the business passenger segment up to this market share. Given earlier research showing that the presence of a low cost carrier substantially reduces the average fare (Windle & Dresner, 1995; Dresner et al., 1996), at low cost carrier market shares above 30 percent, this premium can no longer be extracted and price dispersion and average fare both fall.

It is also interesting to note that price dispersion is low in monopoly markets, many of which are controlled by preeminent low cost carrier Southwest Airlines. At least as of the third quarter of 1995, Southwest did not appear to practice yield management and, by extension, price discrimination.

Production Constraints

Some proxy for airport capacity limits is generally used in airline pricing studies. Not surprisingly, most studies show that these limits raise average fares. The findings confirm those of Borenstein and Rose that capacity constraints also increase route ticket price dispersion. This result may hold in other settings as well provided that periods of lower demand exist when production capacity is not a constraint. Flights are limited at capacity constrained airports only at the peak demand times in the morning and evening. At other times, airlines are relatively free to add flights. This dynamic appears to result in higher fares at times of peak demand than would be the case without production limitations. At other periods, however, fares are competitive with non-constrained routes.

Insignificant Predictors

Hypothesized relationships with predictors variables for (a) vacation routes, (b) competition from low cost carriers on directly competitive routes, (c) hub airports, and (d) route distance proved not significant. Using a somewhat more sensitive proxy for vacation routes, Borenstein and Rose (1994) found that a concentration of leisure travelers decreased price dispersion. Lack of confirmation of their result may be due to the coarseness of the VAC variable based solely on a route endpoint being a vacation destination. Price dispersion would be expected to increase with heterogeneity of consumer demands; thus routes with either a high concentration of business or leisure passengers should display low price dispersion. Some sort of parabolic function, similar in concept to the NONSTP variable, would best capture the relationship.

Low cost carrier competition on a competing route had not previously been tested. The insignificance of the variable suggests that traditional carriers respond more aggressively to competition on the same route than on a competing route. This result is somewhat surprising in light of Dresner et al. (1996) finding that low cost carrier competition on competing routes substantially lowers average fare.

Likewise, major carrier hub airport as an endpoint also proved insignificant as a predictor of price dispersion. Previous studies have consistently shown that average prices on tickets originating at hub airports exceed those on comparable routes from non-hub originations. Borenstein and Rose (1994) do not test directly for this effect; Hayes and Ross (1998) report conflicting results, so no firm conclusion can be reached.

Finally, the square root of the route distance is insignificant. The $\sqrt{\text{DIST}}$ variable, however, is highly correlated with the proportion of non-stop flights on the route concentration (NONSTP) ($\rho = .72$). The collinearity with the NONSTP variable renders distance insignificant.

CONCLUSION

This study should interest both scholars and practitioners. The results support recent theoretical developments predicting an increase in price discrimination as markets move from monopoly to limited competition. Students of price determination may find these results generalize to other industries. While the literature suggests a similar pattern of price dispersion exists elsewhere, confirmation awaits future research. Immediate candidates are other transportation industries such as trucking, railroads, and shipping. Beyond the transportation industries, other service industries, for example, entertainment and lodging, are beginning to use yield management system and should prove interesting candidates for pricing studies.

While airline marketers are certainly aware of the critical role of yield management to profitability, the model adds to the understanding of price variances across markets. It suggests that low cost carriers will encounter significantly less competitive response from established incumbents by targeting secondary airports in major markets. Finally, the airline history and study results point to the substantial benefits accruing to companies introducing or improving yield management in other service industries.

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APPENDIX

Table A1. Low Cost Carrier Listing, 1995

1. Air South	8. Midway
2. Air Tran	9. Morris Air
3. American Trans Air	10. Reno Air
4. Carnival	11. Southwest
5. Frontier	12. Spirit
6. Kiwi	13. Sun Jet
7. Mark Air	14. Tower Air
	15. ValuJet

Source: DOT, 1996; Dresner, Lin, & Windle, 1996

Table A2. U.S. Airport Endpoint Variables, 1995

Airport	*Code*	*Hub*	*Slot*	*Vacation*	*Airport*	*Code*	*Hub*	*Slot*	*Vacation*
Atlanta, GA	ATL	X			Minneapolis MN	MSP	X		
Boston, MA	BOS	X			New York, NY, Kennedy	JFK		X	
Charlotte, NC	CLT	X			New York, NY LaGuardia	LGA		X	
Chicago, IL, O'Hare	ORD	X	X		Newark, NJ	EWR	X		
Cincinnati, OH	CVG	X			Orlando, FL	MCO			X
Dallas, TX	DFW	X			Palm Beach, FL	PBI			X
Dayton Beach, FL	DAB			X	Phoenix, AZ	PHX	X		
Denver, CO	DEN	X			Pittsburgh, PA	PIT	X		
Detroit, MI	DTW	X			Reno, NV	RNO			X
Ft. Lauderdale, FL	FLL			X	Salt Lake City, UT	SLT	X		
Ft. Meyers, FL	RSW			X	San Juan, PR	SJU			X
Honolulu, HI	HNL			X	Sarasota, FL	SRQ			X
Houston, TX	IAH	X			Seattle, WA	SEA	X		
Jacksonville, FL	JAX			X	St. Louis, MO	STL	X		
Las Vegas, NV	LAS			X	St. Petersburg, FL	PIE			X
Los Angeles, CA John Wayne	SNA		X		Tallahassee, FL	TLH			X
Memphis, TN	MEM	X			Tampa, FL	TPA			X
Miami, FL	MIA	X		X	Washington, DC National	DCA		X	

Source: Windle & Dresner, 1995