# THE DOMINANT-FIRM ADVANTAGE IN MULTIPRODUCT INDUSTRIES: EVIDENCE FROM THE U. S. AIRLINES*

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In many industries, the largest firms are most successful in entering and competing in individual markets or submarkets. While this success is often attributed to cost or quality differences, it may also reflect reputation advantages or marketing strategies that benefit firms selling a wider variety of products in the industry. I present an approach to estimating the advantages of a dominant firm in the airline industry that allows one to effectively control for cost and quality heterogeneity. Results using data from 1986 indicate that an airline with a dominant presence at an airport will have a significant advantage in attracting customers whose trips originate at that airport, regardless of the specific route on which the customer is traveling.

## I. INTRODUCTION

Recent concerns about competition in the airline industry have focused in part on the effect of airport dominance in creating and protecting market power on specific routes. When an airline serves a large share of the traffic at an airport, it has been argued that the airline may have an advantage over other carriers in attracting travelers whose trips originate at the airport.[1] In examining such allegations of market failure, however, one must be careful to distinguish market power from cost and quality differences that often favor larger firms. Unfortunately, data on quality and production costs frequently are unavailable or suffer from substantial measurement error. This paper utilizes an innovative approach to controlling for these factors and thus allows a clear focus on the competitive advantage of large, multiproduct firms.

The explanations for the advantage of a dominant airline include natural factors, such as reputation and information spillovers, and marketing devices, such as frequent-flyer programs (FFPs). The possibility of a reputation advantage for large firms

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1. See Levine [1987], Borenstein [1989], and U. S. Congressional Budget Office [1988].



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that offer many products is present in any industry in which companies sell a multiproduct line of goods or services. Likewise, though airlines pioneered FFPs, similar programs have been instituted in many service industries in which each firm sells multiple products, often differentiated by location. Because these programs require minimum purchases before any bonus is given, and because they offer increasing marginal bonuses with higher purchase volume, they may encourage the buyer to make all of her purchases with one, or just a few, sellers. Once the buyer recognizes the advantage of concentrating her purchases in this way, she may then prefer the firm with the most products that she is likely to buy in the future: for example, the airline with the most flights from her home city, the hotel or rental car company with the most outlets in the places to which she travels, or the credit card that is accepted at the most places that she makes credit-card purchases.[2]

The possible anticompetitive effects of FFPs are now a focus of attention in the airline industry, where the carriers have also instituted a similar program that gives bonuses to travel agents after they meet specified minimum booking levels with an airline. The airline industry offers the most attractive opportunity for studying the effects of these programs, both because detailed purchase data are available and because there are many easily defined geographical divisions of the industry: flights to and from each airport—each of which includes many markets; flights on given airport-pair routes—and across which variations in the gains from dominance may be compared.

To estimate the advantage from airport dominance, I examine a natural relationship between pairs of products sold by airlines. The approach is most easily described with a simple example. On a given route, Dallas (DFW) to Atlanta (ATL) for instance, two types of round-trip tickets are commonly sold, those originating at Dallas and those originating at Atlanta. The former type of round-trip can be described as DFW-ATL-DFW, the latter as ATL-DFW-ATL. Each type of ticket includes one Dallas to Atlanta journey and one Atlanta to Dallas journey. Thus, many of the factors that vary across routes and may influence an airline's share of traffic on a route do not vary between these two types of round-trip tickets. Flight frequency, attractiveness of facilities and aircraft, on-time record, food quality, and employee courtesy will not differ for

2. See Banerjee and Summers [1987] and Borenstein [1988] for models of the loyalty-inducing effects of frequent-flyer programs.

round-trip travelers on the DFW-ATL route depending on their point of origin.[3] In fact, even a carrier's fares on a route do not vary by point of origin.[4]

Yet, if dominance of a passenger's originating airport gives an airline a competitive advantage, a comparison of this type may be quite helpful in revealing it. In the Atlanta-Dallas market, for instance, American Airlines, which dominates operations at Dallas, carries 40 percent of the round-trip travel on the route that originates at Dallas, while it carries just 11 percent of the round-trips originating at Atlanta. Delta and Eastern, each with major hubs at Atlanta, together carry 88 percent of the round-trips on this route that originate at Atlanta and 59 percent of those starting at Dallas.[5]

The results of this approach indicate that an airline that carries a large share of the traffic originating at an airport will be able to attract a disproportionate share of the traffic on any particular route from that airport. An airline's share of the traffic on any particular route from an airport will increase by one-quarter of a percentage point when its share of originating traffic on all other routes from that airport rises by one percentage point.

Section II discusses in greater detail reasons that an airline that dominates traffic at an airport might be able to attract a disproportionate share of the passengers on any given route who originate their travel at that airport. The econometric model and the method of estimation are presented in Section III. Section IV presents and interprets the results of the estimation. Concluding remarks are in Section V.

## II. Explaining the Competitive Advantage of a Dominant Firm

If firm A has a reputation or marketing advantage over others in its industry, that advantage may be manifest as (1) a preference

3. Systematic differences in the time of day at which the two different types of passengers travel a given direction on the route may still cause some asymmetry in schedule convenience. This effect is discussed later.

4. Differences in the discount/full-fare mix of passengers, however, could still cause average price to vary by point of origin, an issue discussed later.

5. Here and throughout the paper, the comparison includes only local round-trip passengers. All passengers purchasing only one-way tickets are excluded as are all passengers whose complete itinerary includes more than just the round-trip travel under observation (i.e., all through and connecting traffic). For example, a person traveling from El Paso to Atlanta and back, changing planes at Dallas in each direction (i.e., ELP-DFW-ATL-DFW-ELP), would not be included as an observation on the Dallas-Atlanta route.

among customers, given price and quality of each firm, for firm A's output, or (2) the ability of firm A to credibly threaten retaliation against a potential entrant that would make the entrant's operations unprofitable. As is explained in Section III, the estimation approach applied in this paper to the airline industry isolates only the first of these two effects. In general, when threats of retaliation (or simply competition) from an incumbent prevent all entry, the source of the entry deterrence will be much more difficult to infer. The analysis here focuses on markets in which there are at least two actual competitors.

A phenomenon similar to the hypothesized airport dominance advantage, but still distinct, was first discussed by Fruhan [1972]. He showed that an airline with a large share of the available capacity on a route would generally receive a disproportionate share of the traffic on the route. A common explanation for this effect was that customers who wanted to book a flight would first call the airline that was most likely to offer convenient departure times. That would generally be the airline with the most flights and, therefore, the most capacity on the route. Bailey, Graham, and Kaplan [1985] also found strong evidence of this effect in 1976, but found that the effect diminished substantially by 1981, becoming only marginally significant or statistically insignificant.

An explanation similar to Fruhan's is also consistent with airport dominance (as opposed to route dominance) causing a route-share advantage. If customers do not know which airlines serve a particular route, they might first call the airline that serves the most routes or has the most flights from their originating airport. For a number of reasons, however, this effect alone would probably explain only a very small airport dominance advantage. First, the proportion of people who book their domestic flights without the aid of a travel agent has fallen steadily since deregulation. Only about 20 percent of all domestic tickets are now purchased directly from the airline, down from about 50 percent prior to deregulation. It would be quite difficult to argue that this sort of preference due to imperfect information influences the decisions of travel agents.

Second, the Fruhan result is attributable in part to the fact that prior to deregulation all airlines serving a route necessarily offered the same prices. The benefits to shopping around were thus smaller than they are now; in the 1960s, calling many airlines may have located a more preferred departure time, but it would not have yielded a lower price, as it might today. This may explain why

Bailey, Graham, and Kaplan found that the result had weakened substantially by 1981.

Finally, a Fruhan-like theory can effectively explain differences in traffic share by point of origin in an airport-pair market only to the extent that customers are more knowledgeable of the airline that dominates their originating point than of the airline that dominates their destination point. That is, if a person lives in Dallas and wishes to travel to Atlanta, that person will be more likely to call American first (as a result of imperfect information) only if she knows that American is the major carrier in Dallas, but does not know that Delta and Eastern are the major airlines at Atlanta. This is surely the case for many customers, but for those who have either very little knowledge or substantial knowledge of the industry, it will not be true. Thus, the extent of this explanation is further limited.

Other information-based hypotheses are also suggested to explain an airport dominance effect. Advertising, for instance, is likely to have a greater impact per dollar for an airline that serves many routes from a city than for one that serves few routes. This and other scale economies in the production and effectiveness of advertising are likely to lead the dominant airline to do more local advertising than carriers with smaller operations in a city. Similarly, if travel on an airline is to some extent an experience good, then an airline offering a wide variety of products will increase the likelihood that a customer flying on a certain route will have already tried other services by that airline. Because acquiring information is costly, ceteris paribus, the consumer may prefer the airline on which he has already flown.

These information and advertising effects are present in the national hotel and car rental industries as well. In those industries a consumer is generally much less interested in the various companies' offerings in his home city, but he collects information from national advertising and from exposure to the companies during travel to other cities. If he has seen one rental car company's advertisements or has had a good experience with that company in past travels, he may prefer it during future trips. Such information or reputation spillovers have been one motivation for the formation of outlet chains with standardized products in many industries. In fact, these advantages could be present in the sale of any goods or services purchased primarily by consumers unfamiliar with the prices and quality choices in a particular market. A familiar brand name—whether for rental cars, hotels, air travel, fast food, large appliances, or mail-order clothing—in an unfamiliar physical location or product market may be a substantial attraction to a risk-averse buyer.

While the nature of the airline industry might necessarily imply that these information advantages will flow to the major carrier in a city, airlines have in recent years created new marketing devices that may augment these advantages. Frequent flyer programs (FFPs), for example, are recognized to induce brand loyalty and are argued to be particularly beneficial to a dominant carrier in an area. If an airline serves more routes and has more flights from a city, then (1) the majority of a local resident's future flights are more likely to be on that airline than on any other and (2) that airline is likely to serve a wider variety of "payoff" destinations from the city, destinations that are particularly attractive prizes to be awarded as FFP bonuses. The importance of the former effect is a result of the nonlinearity of FFP payoff functions, which encourages customers to accumulate all FFP points on as few airlines as possible. The latter effect might be seen as an artificial network economy. By tying travel today to future travel on "any route we serve in the United States," the carrier creates an option on future travel that increases in value with the variety of points served by the airline from the FFP member's home airport.[6]

A similar nonlinear payoff schedule exists in many of the commission arrangements established between an airline and the travel agents who sell its product. Travel agent commission override programs (TACOs) are contracts between an airline and a travel agent in which the airline agrees to increase the agent's proportional remuneration, usually in the form of higher commission rates, if the agent reaches certain sales goals. In some cases, override payments are based on the dollar volume of the agent's sales for the airline, e.g., the commission rate is raised from 10 percent to 12 percent if the agent sells more than $100,000 of travel on the airline in a month. In other cases, these bonuses depend upon the *share* of the agent's business that goes to the airline, e.g.,

6. This option value can be replicated to some extent by smaller carriers through the formation of affiliated FFPs, in which the points earned on many different carriers can be combined to receive a free trip on any one of those airlines. Still, the costs—both the sunk costs of establishing such agreements and the variable costs of enforcing them—seem to be quite high. See Levine [1987] and Borenstein [1988] for more complete descriptions of the connection between airport dominance and FFP advantages.

the commission rate is raised from 10 percent to 12 percent if more than 50 percent of the agent's air travel sales are with that airline.[7] Again, this marketing device may be used most effectively by the dominant carrier at an airport for the purpose of biasing brand choice in travel purchases.[8]

Computer reservation systems (CRSs) also may be used to bias the airline choice of travel agents and thus, of consumers. Though the Civil Aeronautics Board in 1983 banned the most blatant display bias—the practice of an airline that owns a CRS listing its flights before those of other airlines—there is evidence that more subtle biases may remain, though interpretation of these data is open to dispute.[9] An airline is still thought by some to have an advantage in gaining bookings from travel agents that use its CRS. In part, this advantage may be due to the use of CRSs in implementing those TACOs that link the commission override to the share of airline bookings that an agent makes on a certain airline. Calculation of such a share figure requires data on all of the agent's bookings, data that will be immediately available to the airline that owns the CRS that the agent uses for ticketing. In most cases where a dominant airline in a city also operates a CRS, the travel agents tend to prefer that CRS over others. Thus, CRS ownership may further enhance the advantage of a large traffic share.[10]

A significant feature of all three of these marketing devices—FFPs, TACOs, and CRSs—is that they work to some extent by exploiting a principal-agent relationship. Frequent flyer plans are designed in part to bias the decision making of a business flyer in the purchase of travel services paid for by her company. The agent does not fully internalize the principal's cost of marginal expenditures on travel. Such expenditures are then rewarded with private payoffs to the agent. Though firms can monitor FFP bonuses and

7. Override bonuses are not always just higher monetary payment; some airlines pay off in the form of free travel or additional tickets given to the agent for which the agent can keep all revenues.

8. See Levine [1987], D.O.T. [1988], and *Travel Weekly* [1988] for more complete descriptions of TACOs and their effects.

9. See Levine [1987], Department of Transportation [1988], U.S.D.O.T. USAir/ Piedmont Acquisition Case, Docket 44719.

10. A travel agent's preference for the CRS owned by the dominant carrier in its area could have nothing to do with anticompetitive marketing devices. The CRS that an airline owns will be the one that most quickly receives and processes information about that airline's changes in schedule, fares, etc. Quick access to this information is more important for the agent as it relates to the locally dominant airline than to other airlines that have smaller operations in the area. Thus, the agent would prefer the dominant carrier's CRS.

require that they be used for business travel, very few firms actually do this.[11] Similarly, few customers are able to monitor their travel agents' bias due to commission override programs. Yet, these payments to the agent can have significant effects on the purchase made by the principal.[12] Bias in the presentation of information in a CRS also may reflect the differing goals of the purchasing customer (the principal) and the owner of the CRS (the agent). To the extent that these marketing devices rely on persuading an agent to make a choice that is not in the best interest of the principal, it is likely that some inefficiency results.

Though the marketing devices that have been pioneered by airlines could be applied to almost any industry, successful adoption is probably most likely in service industries, particularly ones that are travel related or sell to business people. The nonlinear bonus schedules associated with FFPs and TACOs require prevention of resale, which is generally easier in the sale of services than goods. Exploitation of a principal-agent relationship is more likely when a business person is buying for her company. The principal will have higher monitoring costs when the product purchased is not standardized, which is often the case with travel itineraries and is generally more common with services than with goods. Finally, programs like FFPs that give bonuses to the consumer seem likely to be most successfully employed by firms that sell multiple products or have outlets in many different locations where a consumer is likely to want to purchase the product.

It is almost surely the case that each of the effects discussed here—"natural" information imperfections, advertising economies, FFPs, TACOs, and CRSs—makes a nonzero, though possibly small, contribution to giving a dominant carrier a competitive advantage. Because data on these possible causes are unavailable, except for CRS operations, it will be difficult to determine with certainty the importance of each possible explanation. It is possible, however, that some information can be gleaned by noting

11. Firms can reduce salary to adjust for the *average* FFP "fringe benefit" that a certain employee is expected to receive. Though this lessens the loss to the firm from the principal-agent problem, it does not lessen the incentive on the margin for the employee to make inefficient decisions. Because FFP rewards from business travel are untaxed fringe benefits, it may be in the interest of both the employee and the employer to allow this kickback to continue.

12. In a recent poll of 702 travel agencies, more than half said that their choice of carrier was affected by override payments "usually" (24 percent) or "sometimes" (27 percent). Thirteen percent said "rarely," and 35 percent said "never." See *Travel Weekly,* June 29, 1988, p. 94.

characteristics of the routes on which the airport dominance effect seems to be greatest. I do this in one dimension by measuring the effect of a route's business/tourist traffic mix on the importance of the airport dominance advantage.

This distinction could be particularly helpful in determining the importance of frequent flyer programs and, possibly, TACOs. If the primary cause of the advantage is natural information economies, or even economies of scale in advertising, then less frequent and less well-informed passengers will probably be more likely to respond to dominance. On the other hand, if the cause is marketing devices designed to attract repeat business, e.g., frequent flyer programs, then more frequent travelers will be more strongly affected. Thus, the former explanations are likely to lead to a greater advantage on tourist-oriented routes, where a smaller proportion of the passengers are frequent travelers, while a greater effect on business routes would support the latter hypothesis.

Whether TACOs are more likely to bias the carrier choice of business or of tourist travelers is less clear. If business travelers are better informed, then they may be able to more easily monitor travel agent behavior, so the effect of TACOs would be greater for tourist travel. The higher time value of business travelers, however, may make them less likely to monitor and therefore make them more susceptible to the bias induced by TACOs.[13] In addition, bias due to TACOs might also be greater for business travel because these programs are often used to give volume discounts to corporate customers through the firms' in-house travel agency. Overall, theory and the established institutions make ambiguous the effect that one would expect the proportion of tourist travel on a route to have on an airport dominance advantage attributable to TACOs.

## III. Estimation Technique and Functional Forms

The estimation of the effect of airport dominance takes advantage of the fact that many variables thought to affect route share take on the same value regardless of which end of a city-pair

13. A similar point may be made regarding the "natural" information differential between business and tourist travelers. Even if tourist travelers are less well informed, their lower value of time and, perhaps, higher marginal value of money, as compared with business travelers, may cause them to collect more information for a specific trip while searching for lower prices, thus overcoming their information disadvantage.

market is the origin of a customer's round-trip. Thus, if the structural equation for route share is additively separable in these factors, they can be eliminated from the estimation by studying the difference in an airline's share of the passengers originating at each endpoint of a route. I posit the following functional form:

$$SHARE_{ij} = \Gamma(X^1_{ij}) + \Omega(X^2_{ij}) + \epsilon_{ij}, \tag{1}$$

where $SHARE_{ij}$ is an airline's share of the round-trip traffic on the route between point $i$ and point $j$ that originates at point $i$. The first set of right-hand-side variables, the vector $X^1$, differs within a route as a function of the origination point of the passenger's trip, $X^1_{ij} \neq X^1_{ji}$, while the second set of variables does not, $X^2_{ij} = X^2_{ji}$. A stochastic component of route share by point of origin, $\epsilon_{ij}$, is also assumed. If we then consider the difference in an airline's share of traffic on a route by point of origin, the second set of variables is eliminated:[14]

$$SHARE_{ij} - SHARE_{ji} = \Gamma(X^1_{ij}) - \Gamma(X^1_{ji}) + \epsilon_{ij} - \epsilon_{ji}. \tag{2}$$

This equation could be estimated as a linear function, but the estimates would suffer some bias due to the limited range of the dependent variable, $[-1,1]$, which implies a nonnormal distribution of the error term. Since there is no obvious functional relationship that presents itself as superior to all others, this difficulty is most easily handled with a logistic transformation of each route share variable before the differencing.[15] Thus, instead of (1), I assume that the underlying relationship is

$$LGSHARE_{ij} = \Gamma(X^1_{ij}) + \Omega(X^2_{ij}) + \epsilon_{ij}, \tag{1$'$}$$

where $LGSHARE_{ij} = \ln[SHARE_{ij}/(1 - SHARE_{ij})]$. The difference in an airline's share on a route by point of origin—the equation that I estimate—becomes

$$LGSHARE_{ij} - LGSHARE_{ji} = \gamma*[X^1_{ij} - X^1_{ji}] + \epsilon_{ij} - \epsilon_{ji}. \tag{2$'$}$$

14. If the variables in $X^1$ and $X^2$ are not additively separable, then this differencing would not eliminate the $X^2$ variables. Still, as long as only a scalar function of the $X^2$ variables interacts with the $X^1$ variables, this scalar can be estimated as an interactive route/carrier specific fixed effect. The problem with this approach is that each route/carrier fixed effect is then estimated with only two observations per route (based on the observations of passengers originating at each endpoint of the route). When such a model was estimated by nonlinear least squares, the parameter estimates on (O)APTDOM and (O)APT*TOUR were identical in sign and similar in magnitude. The standard errors of the estimates, however, increased somewhat.

15. Estimates of the linear form, equation (2), are identical in sign and similar in magnitude, but not quite as significant as estimates of (2)'. The linear estimates are also more sensitive to changes in the route share criteria for inclusion in the sample that are discussed in footnote 18.

The difference between the stochastic components is assumed to follow an i.i.d. normal distribution.[16]

The logistic transformation is not defined when the variable is zero or one, so observations in which either by-origin route share, $SHARE_{ij}$ or $SHARE_{ji}$, is zero or one must be excluded from the sample.[17] In fact, also excluded from the results presented are routes on which the observed carrier has less than 5 percent or more than 95 percent of the total traffic on the route in both directions ($RUTSHARE_{ij} < 0.05$ or $RUTSHARE_{ij} > 0.95$). Nearly all routes excluded due to the restriction from the logistic transformation would also be excluded on the second criterion. The justification for this sample selection is that if a carrier has less than 5 percent of the traffic, it is not really an active competitor in the market, while a share of more than 95 percent is indicative of monopoly. In neither of these cases is the model likely to have as much predictive power. The arguments discussed in Section II are much more relevant to interaction among competitors on routes with more than one significant participant.[18]

An $F$-test could not reject pooling across carriers and the pooled data set is significantly larger than for any individual carrier, so the pooled results are presented. By-carrier estimated parameters were generally of the same sign as the estimates from pooling, particularly for the largest carriers for which the most observations were available.[19] Inclusion of all by-carrier observations in a pooled sample would be misleading, however, because some observations are for different carriers on the same route. In

16. In theory, the differencing by point of origin also eliminates the intercept term from the equation to be estimated. The results presented include an intercept term, which is insignificant in every regression, because there could be a systematic bias due to the order in which the airports are listed within any airport pair: the larger airport is always the first listed in a pair. There is virtually no change in the estimates when the intercept term is omitted.

17. The logistic transformation of the dependent variable is not inconsistent with the assumption of a normally distributed error term. If the error term had been normal before the transformation, then this would not be a reasonable assumption, but the transformation is used precisely because the error is not believed to be normal before the transformation. The logistic transformation also has the appealing property that it allows the marginal effect of the $X^1$ variables to diminish if $SHARE$ is near zero or one.

18. Other boundary restrictions, (2 percent, 98 percent) and (10 percent, 90 percent), yielded very similar results.

19. Though pooling of all carriers could not be rejected, the by-carrier regressions did indicate that the larger and more sophisticated airlines may garner bigger advantages from airport dominance. For this reason, I repeated the analysis using a pool of observations for only the four largest domestic airlines: American, Delta, Eastern, and United. These are also four of the five airlines that owned a CRS in 1986, the last being TWA, which had much smaller scale domestic service. The results, which are available from the author, indicate a somewhat stronger advantage from airport dominance, but the difference is not statistically significant.

fact, most multicarrier markets have just two significant competitors whose round-trip shares by point of origin sum nearly to one. Thus, not only would the assumption of independent residuals be erroneous, the information in two observations of different carriers on the same route would be virtually redundant. Pooling was done by picking randomly from the carriers on each route that met the boundary criteria.[20]

The remainder of this section discusses the variables that are in $X^1$, and therefore included in the regressions because of their asymmetric effect on share depending on point of origin, and in $X^2$, and therefore excluded from the estimation because of their symmetric effects on route share by origination point.

*A. Asymmetric (Included) Variables That May Affect Route Share*

*Airport Dominance Measures.* I have measured airport dominance in a number of ways with consistent results. The regressions presented use an airline's share of the passengers who originate their trip at a given airport and travel on any route other than the route in the observation (APTDOM). So, for instance, American Airline's share of traffic at Dallas for use in the observation of the Dallas-Atlanta route would be all American passengers originating at Dallas, but not traveling on the Dallas-Atlanta route, divided by all passengers originating at Dallas on any airline, but not traveling the Dallas-Atlanta route. Alternative measures that were tried with very similar results were share of aircraft departures, share of seat-departures (so as to weight by plane size), and share of seat-mile-departures (so as to weight by plane size and the "average size of purchase" (distance) made by each firm's customers).[21]

Besides the advantage in attracting customers to its flights over a competitors,' airport dominance might also allow an airline to deter entry of competitors. This could be done with a threat of retaliation, possibly made more credible due to airport dominance,[22] or by blocking access to scarce gates or landing slots at an airport.[23] The estimation carried out here would not detect such an effect. Analysis of share difference as a function of point of origin

20. The loss of many observations for the pooled sample means that only these same observations could be used in the corresponding by-carrier regressions run to carry out a Chow test for pooling. This limited the power of such a test.
21. Results of these alternative regressions are available from the author.
22. See Borenstein [1988].
23. See *Wall Street Journal,* July 20, 1987.

takes as given (actually, removes in the differencing) the capacity offered by an airline and each of its competitors on a route. If, in fact, an airline were to successfully deter all entry onto a route, it would have a 100 percent share of the route traffic originating at each endpoint and the estimation herein would be unable to detect any airport dominance effect. This observation also supports the boundary share restrictions on the sample that were explained earlier.

If dominance of a customer's originating airport confers market power, then the differences in an airline's share of traffic on a route by point of origin will be not just a positive function of the airline's difference in airport dominance, but also a negative function of the difference in airport dominance of the other airlines against which it competes on the route (OAPTDOM). Both variables are included in the regressions.

*Modification of Airport Dominance Effect by Tourist Traffic.* As explained earlier, one approach to distinguishing among the competing explanations of airport dominance advantages is to observe which kind of passengers are most strongly affected by dominance. To analyze the effect of business/tourist mix, I include an interaction of the airport dominance variable with a measure of the tourist orientation of the destination city. The tourism index is essentially a measure of the proportion of total metropolitan income that is derived from hotels and other lodgings that serve primarily tourist or group travel. Thus, on the L.A.-Honolulu route, for the L.A.-originating passengers, this variable would be the L.A. airport share of the observed carrier multiplied by the Honolulu tourism measure. Conversely, the measure for passengers originating at Honolulu would be the carrier's Honolulu airport share times the L.A. tourism measure. The tourism interaction variable enters as modifying both the advantage of a carrier's own airport dominance (APT*TOUR) and the disadvantage of the airport dominance of the other airlines on a route (OAPT*TOUR).

*Computer Reservation System Share.* If bias in the presentation of flights on a CRS can bias a travel agent's or passenger's decision regarding airline choice, then a dominant CRS share in a city would lead to an advantage in attracting the passengers who originate there. Furthermore, if the CRS allowed an airline to more effectively implement and monitor TACOs, CRS share may reenforce the effect of airport dominance. An airline's CRS share in a city is measured as the proportion of revenues from air travel bookings on all CRSs in a city that are on the CRS owned by that airline.

CRS effects may be very difficult to distinguish from airport dominance effects, due to their high correlation.[24] If a large CRS share gives an airline large shares of traffic on all routes from an airport, then the airline may also display airport dominance. Similarly, if travel agents are attracted to adopt the CRS of the dominant airline in an area, the two effects will be confused.[25] As with the previous variables, both the endpoint difference in CRS share of the observed firm (CRS) and the average endpoint difference in CRS share of others that it competes against (OCRS) on the route may affect the difference in the observed firm's route share by point of origin.

*Schedule Convenience.* It was argued above that the difference in frequency of flights by direction on a route will not affect differences in route share by point of origin, because regardless of point of origin, a round-trip journey will include one flight in each direction. Though this is true, the convenience of schedule times might affect the relative attractiveness of a carrier to customers at each endpoint of a route. For example, American might have a larger share of the Dallas-originating passengers than the Atlanta-originating passengers on the Dallas-Atlanta route, because most of its flights on the route are DFW to ATL in the morning and ATL to DFW in the evening. To control for this possible effect, an index of share of convenient flights by point of origin was constructed. Convenient flights were taken to be those nonstop flights that leave the traveler's originating point between 6 A.M. and 10 A.M. on a weekday morning plus those that depart between 4 P.M. and 8 P.M. on a weekday evening to return to the point of origin. For each market in which an airline competes, it will have a share of the convenient flights for each endpoint. The variable used to account for schedule convenience differences is the difference between endpoints in a carrier's share of the convenient flights (SCHDCONV).[26]

24. Among the 71 airports for which local CRS share data are available, the correlation between origination share and CRS share is 0.71 for Eastern, 0.69 for Delta, 0.67 for TWA, 0.61 for United, and 0.48 for American.

25. Though this interaction may lead to multicollinearity, it is unlikely that the traffic shares on an individual route (the right-hand-side variable) has a substantial effect on travel agents' CRS choice, so there is not an issue of endogeneity.

26. Schedule convenience may differ in importance depending on the length of the trip. In Section IV estimates are discussed for the case in which the coefficient is restricted to be the same for all routes and when it is allowed to differ in three different distance categories.

*B. Symmetric (Excluded) Variables That May Affect Route Share*

Though the variables discussed in this section do affect an airline's share of traffic on a route, their effects on route share would not differ substantially depending on the endpoint of a route at which a traveler originates her trip. The logic of excluding many variables is obvious. For instance, meal quality differences among competitors may affect route share, but not by point of origin. Similarly, the attractiveness of the airport facility is not likely to have asymmetric effects, because regardless of origin point, each facility is used for one departure and one arrival on a round trip. Many direction-specific variables may be excluded because the round-trip traveler takes one flight in each direction. For instance, the flights in one direction on a route may tend to make more intermediate stops than in the opposite direction, but a customer would experience the imposed inconvenience in each direction one time. One variable, however, requires a more thorough discussion: Price.

The difference in shares of passengers on a route as a function of the origination point on the route is unlikely to be explained by fare differences. Fares on a route are virtually always offered without reference to the traveler's point of origin, i.e., the set of DFW-ATL-DFW fares on Delta will be the same as the set of fares they offer for ATL-DFW-ATL travel. Still, if there are certain flights that are more attractive to ATL originating passengers than DFW originating passengers, e.g., 7 A.M. Monday morning from ATL to DFW, a firm that dominates traffic at ATL may be able to more effectively fill these planes with full-fare passengers, and so may allocate fewer discount seats to this flight than to the equivalent flight in the opposite direction, i.e., 7 A.M. Monday morning from DFW to ATL. This difference in the allocation of discount seats that results from unequal demand could create differences in average price.

In the data set differences in a carrier's average price on a route by point of origin are not significantly correlated with its difference in airport origination share ($\rho = 0.016$), but are significantly correlated (at the 5 percent level) with the differences in origination share of competing carriers on the route ($\rho = -0.079$) and differences in the observed carrier's route share by point of origin ($\rho = 0.077$).[27] The problem with including price difference in

27. These correlations come from a slightly restricted data set that omits observations in which average price was not reliably reported. See description of the *PRICE* variables in the data appendix.

TABLE I
DESCRIPTIVE STATISTICS

| Variable | N | Mean | Standard deviation | Minimum value | Maximum value |
|---|---|---|---|---|---|
| Undifferenced variables | | | | | |
| Observed airline | | | | | |
| SHARE | 1896 | 0.352273 | 0.261573 | 0.004000 | 0.980000 |
| APTDOM | 1896 | 0.146201 | 0.136510 | 0.000000 | 0.722000 |
| APT*TOUR | 1896 | 0.002149 | 0.004166 | 0.000000 | 0.037730 |
| CRS | 1574 | 0.162826 | 0.243533 | 0.000000 | 0.915000 |
| SCHDCONV | 1168 | 0.338199 | 0.320441 | 0.000000 | 1.000000 |
| Other airlines on route | | | | | |
| OAPTDOM | 1896 | 0.159122 | 0.124744 | 0.003000 | 0.955000 |
| OAPT*TOUR | 1896 | 0.002299 | 0.003708 | 0.000014 | 0.031350 |
| OCRS | 1574 | 0.168729 | 0.181099 | 0.000000 | 0.915000 |
| Differenced by point of origin on the route | | | | | |
| Observed airline | | | | | |
| LGSHARE | 948 | 0.019315 | 0.768471 | −3.625719 | 6.088036 |
| APTDOM | 948 | 0.023227 | 0.198187 | −0.558000 | 0.507000 |
| APT*TOUR | 948 | 0.000525 | 0.005462 | −0.028734 | 0.037178 |
| CRS | 787 | 0.022839 | 0.223920 | −0.765000 | 0.880000 |
| SCHDCONV | 948 | −0.005234 | 0.157335 | −1.000000 | 1.000000 |
| Other airlines on route | | | | | |
| OAPTDOM | 948 | 0.011430 | 0.182403 | −0.827000 | 0.452000 |
| OAPT*TOUR | 948 | 0.000191 | 0.004667 | −0.030904 | 0.030948 |
| OCRS | 787 | 0.020657 | 0.170394 | −0.633000 | 0.748000 |

*Notes.* Observations on undifferenced variables for each endpoint (e.g., APTDOM1 and APTDOM2) are presented together in this table (e.g., as APTDOM).
See Data Appendix for explanation of variations in number of observations.

the regressions is that it is clearly endogenous. In this case, a useful identifying instrument is quite difficult to find because it must be correlated with the difference in average prices by point of origin, but not causally affected by differences in by-origin route share. Because no useable instrument was identified, the difference in price was tried as a right-hand-side variable ignoring the endogeneity; the estimated coefficient was positive, but insignificant, in every regression in which it was entered. Price difference is excluded from the regressions presented. The positive correlations among price differences, route share differences, and airport share differences by point of origin imply that the bias from omitting price difference would probably be to estimate smaller effects of airport dominance on route share than in fact exist.[28]

28. This statement assumes that the actual own-price elasticity of demand faced by an individual carrier on a route is negative.

TABLE II

| Dependent variable: LGSHARE | | | |
|---|---|---|---|
| INTERCEPT | 0.01 | 0.01 | 0.02 |
| | (0.02) | (0.02) | (0.03) |
| APTDOM | 0.97[a] | 1.15[a] | 1.14[a] |
| | (0.12) | (0.15) | (0.19) |
| APT*TOUR | | −13.13[b] | −15.36[b] |
| | | (6.05) | (7.27) |
| CRS | | | 0.17 |
| | | | (0.14) |
| OAPTDOM | −0.90[a] | −1.15[a] | −1.22[a] |
| | (0.13) | (0.16) | (0.20) |
| OAPT*TOUR | | 17.99[a] | 14.80[c] |
| | | (6.93) | (8.00) |
| OCRS | | | 0.00 |
| | | | (0.18) |
| SCHDCONV | 0.71[a] | 0.74[a] | 0.77[a] |
| | (0.15) | (0.15) | (0.17) |
| OBSERVATIONS | 948 | 948 | 787 |
| $R$-SQUARED | 0.134 | 0.140 | 0.154 |
| $F$-RATIO | 48.48[a] | 30.79[a] | 20.32[a] |

*Note.* All variables are differenced by point of origin.
a. Significant at 1 percent level.
b. Significant at 5 percent level.
c. Significant at 10 percent level.

## IV. Results and Interpretations

The base sample of routes from which the observations are drawn is the 1,200 largest airport-pair markets in the United States during the second quarter of 1986, the time period of the data. Of these routes nearly 50 were removed due to severe reporting inconsistencies.[29] In the full sample that had no significant reporting problems, there were 948 routes on which at least one carrier had more than 5 percent of the round-trip traffic, but less than 95 percent.

The primary regression results, presented in Table II, demonstrate the strong effect of airport dominance on route share. The signs of the effect of an airline's own origination share (APTDOM) and that of its opponents (OAPTDOM) are consistent and signifi-

29. United, for instance, failed to distinguish its La Guardia Airport traffic in New York from its Kennedy Airport traffic, thus making route share calculations impossible for any route including either airport and on which United had service. On some routes, virtually no round-trip tickets were reported, probably because the carriers (usually People's Express or New York Air) recorded travel only by directional journey, failing to report that two opposite directional trips on a route were part of a single round-trip ticket.

cant in every regression. Inclusion of the CRS data requires exclusion of routes with either endpoint outside of the 57 metropolitan areas for which CRS data were available, which decreases the sample size by about 17 percent.

Ignoring for a moment the modifying effect of the tourism interaction terms, the parameter estimates for APTDOM and OAPTDOM generally indicate that a one-percentage-point increase in share of originating passengers at the endpoint will yield a change of 1.0 to 1.2 in the logistically transformed dependent variable. At the average route share in the sample, about 35 percent, this translates to an increase in route share of 0.22 to 0.26 percentage points.[30] This will be the case if the gain in airport share is not at the expense of opponents on a route. If all gains in airport share are taken from an airline that competes on the observed route (though the gain in airport share would come from routes other than the one observed), then a one-percentage-point increase in airport share would have twice as large an impact on the carrier's route share.

Table III presents an attempt to trace out somewhat more precisely the effect of airport dominance on route share. The estimates in this table are from a piecewise linear model of the effect of origination share on the logistically transformed dependent variable. The tourism modifying effects and CRS effects are omitted, because the collinearity of these variables made most estimates insignificant with large standard errors. The table indicates that changes in airport share are likely to have the largest effects on route share when the carrier has between zero and 20 percent of the airport originations (APTDOM00-20, OAPTDOM00-20). The marginal effect appears to be smaller for airport shares in the 20 to 40 percent range (APTDOM20-40, OAPTDOM20-40), but then again increases and is fairly statistically significant in the 40 to 60 percent range (APTDOM40-60, OAPTDOM40-60). The very small number of observations in the highest range (APTDOM60+, OAPTDOM60+) makes these results statistically unreliable.[31] One

30. The derivative of route share with respect to a change in the logistically transformed route share variable depends on the level of the share variable. The derivative is a parabolic function with the maximum value when share is 50 percent and minima when share is 0 percent or 100 percent. To give some idea of the range, the derivative is 0.25 when share is 50 percent, 0.24 when share is 40 percent or 60 percent, 0.19 when share is 25 percent or 75 percent, 0.09 when share is 10 percent or 90 percent, and 0 when share is 0 percent or 100 percent.

31. There are only two observations in which APTDOM60+ is nonzero and five observations in which OAPTDOM60+ is nonzero. APTDOM40-60 is nonzero in 146 observations, OAPTDOM40-60 in 121, APTDOM20-40 in 476, and OAPTDOM20-40 in 487.

TABLE III
PIECEWISE LINEAR ESTIMATION OF THE EFFECT OF ORIGINATION SHARE

| | Dependent variable: LGSHARE |
|---|---|
| INTERCEPT | 0.02 |
| | (0.02) |
| APTDOM00-20 | 2.20[a] |
| | (0.32) |
| APTDOM20-40 | −0.64 |
| | (0.44) |
| APTDOM40-60 | 2.18[b] |
| | (0.89) |
| APTDOM60+ | −5.98 |
| | (5.18) |
| OAPTDOM00-20 | −1.18[a] |
| | (0.33) |
| OAPTDOM20-40 | −0.67 |
| | (0.43) |
| OAPTDOM40-60 | −1.82[c] |
| | (1.08) |
| OAPTDOM60+ | 1.12 |
| | (1.51) |
| SCHDCONV | 0.71[a] |
| | (0.15) |
| OBSERVATIONS | 948 |
| $R$-SQUARED | 0.154 |
| $F$ RATIO | 18.89[a] |

*Note.* All Variables are differenced by point of origin
a. Significant at 1 percent level.
b. Significant at 5 percent level.
c. Significant at 10 percent level.

might interpret the effect in the zero to 20 percent range as an effect of presence, which may be more attributable to information advantages, while the 40 to 60 percent marginal effect could be due to dominance and more attributable to loyalty-inducing marketing devices. Many other interpretations are also certainly possible.

The average value of the tourism index is about 0.01, with a range from virtually zero to 0.07. With a parameter estimate of, for instance, −14 on the tourism/airport-share interaction term (APT*TOUR), the advantage of airport dominance would be about one-sixth as great on the most tourist-oriented routes as compared with completely nontourist routes.[32] As explained in the Appendix,

32. The tourism index 0.07 multiplied by −14 implies a decrease in the impact of airport dominance of about 0.98, or about five sixths of the parameter estimate for APTDOM.

TABLE IV
REGRESSIONS USING TOURISM DUMMY VARIABLE INSTEAD OF TOURISM INDEX

| | Dependent variable: LGSHARE | |
|---|---|---|
| INTERCEPT | 0.01 | 0.02 |
| | (0.02) | (0.03) |
| APTDOM | 1.02[a] | 0.99[a] |
| | (0.12) | (0.16) |
| APT*TDUM | −0.50[c] | −0.65[c] |
| | (0.30) | (0.36) |
| CRS | | 0.18 |
| | | (0.14) |
| OAPTDOM | −0.99[a] | −1.12[a] |
| | (0.13) | (0.17) |
| OAPT*TDUM | 0.77[b] | 0.79[b] |
| | (0.31) | (0.39) |
| OCRS | | 0.03 |
| | | (0.18) |
| SCHDCONV | 0.73[a] | 0.76[a] |
| | (0.15) | (0.17) |
| OBS | 948 | 787 |
| $R$-SQUARED | 0.140 | 0.154 |
| $F$ RATIO | 30.55[a] | 20.25[a] |

*Note.* All variables are differenced by point of origin.
a. Significant at 1 percent level.
b. Significant at 5 percent level.
c. Significant at 10 percent level.

to adjust for accounting inconsistencies in Nevada cities (where gambling income is included in hotel income) and some other locations, the index is truncated at the upper end. To test for sensitivity to this somewhat arbitrary adjustment, an alternative dummy-variable approach was also used, in which cities with indices above a certain critical value were specified as tourist oriented and all others were not.[33] The results of this alternative approach, shown in Table IV, are consistent with the primary specification of the model; the estimates in Table IV imply that the airport share advantage is about one-half to two-thirds less on tourist-oriented routes than on business-oriented routes. Though these estimates are not always strongly significant, they seem to give greater support to the FFP (and, perhaps, TACO) explanations for the importance of airport dominance than to the costly

33. The dummy-variable approach is similar to that used by Graham, Kaplan, and Sibley [1983], except that I exclude some Florida cities that are not very tourist oriented (e.g., Tallahassee), and I include some cities outside Nevada, Hawaii, and Florida (e.g., Monterey, CA, and Myrtle Beach, SC). See the Appendix for details.

information and economies of scale in advertising hypotheses. Of course, all of these theories probably hold some piece of the explanation, but the results indicate that the new marketing devices may be at least as important as the information and advertising effects.

The effect of computer reservation systems on route share may be captured to a large extent in the airport share measure. There are some cities, however, where a certain CRS is used by many of the travel agents even though the owner-airline is not very active at the local airport. The estimates are fairly consistent in indicating some advantage to the CRS-owning airline, but the magnitude and significance of these estimates vary quite a bit, and the symmetric disadvantage of competing against a CRS-owning firm is not evident. Even the primary estimate of the CRS advantage, around 0.17, indicates that a one percentage-point increase in CRS share would have a direct effect on route share of no more than 0.05 percentage points.

Finally, the schedule convenience variable has the anticipated sign and is strongly significant in all of the regressions. One might expect this variable to be a more important factor for short distance trips than for longer trips, where one-day round-trip travel is not common. To test for sensitivity of the results to this possible misspecification, three different parameters were estimated for, respectively, routes of less than 500 miles, 500 to 1,500 miles, and greater than 1,500 miles. Indeed, the parameter is largest and most significant for the shortest distance category.[34] The restriction to a common parameter could not be rejected, however, and, more importantly, the elimination of this restriction had almost no impact on the estimates of airport share effects—less than a 10 percent change in the parameter estimates in all cases and less than 1 percent in most cases. The insensitivity of the other parameter estimates to the form of the schedule convenience variable is explained by the fact that asymmetries in schedule convenience are not significantly correlated with airport share or CRS share. Airlines are about as likely to have conveniently scheduled flights for people traveling to their dominated airports as for people originating at their dominated airports.[35]

34. Curiously, however, the middle distance category showed smaller and less significant estimates than for long distance, where the effect was nearly as large as for the short distance category.

35. The schedule convenience variable was also respecified to include only flights beteen 7 A.M. and 9 A.M. in the morning and 5 P.M. and 7 P.M. in the evening without any noteworthy change in the results.

### *A. Evidence on a "Knife-Edge" Explanation of the Airport Dominance Advantage*

A critical examiner of the results presented thus far might argue that some airport share advantage is evident, but that the magnitude of that advantage is still difficult to assess. The reason for this conclusion would be that the results presented above do not indicate the price differential that would allow a firm with small airport share to overcome the advantage to a locally dominant airline.

An extreme version of this view would be that a competitive equilibrium among only slightly differentiated firms may leave many customers nearly indifferent among them. As a result, a small change in attractiveness, such as might flow from airport dominance, could induce quite asymmetric market shares. It could still be quite possible then that the competitively disadvantaged firms could compete by charging only slightly lower prices or that the threat of such competition would force the advantaged firm to charge prices very close to a competitive level.

Ideally, one would respond to this argument by estimating the tradeoff between price differentials and airport share differentials in affecting route shares. As explained above, however, average price varies little if at all by point of origin on a route and the effect of price is endogenous with little hope of identification in the specification estimated here. The approach of this paper is therefore not useful in estimating the rate at which price differentials among firms may be used to compensate for airport share differentials.[36]

If airport share advantages were easily overcome by price competition, however, one would expect to see a relationship between airport share and by-origin route share only (or much more strongly) on routes where carriers charge approximately the same prices. When prices differ greatly, dominance at an airport would be of much less consequence. To analyze this effect, Table V presents regressions with the data set stratified by the ratio of the average price of the observed carrier to the average price charged by all other airlines serving the route. The observations have been broken into three groups of approximately equal size. Observations

36. Other studies have estimated significant price premiums charged by airlines that dominate airports or routes. See Graham, Kaplan, and Sibley [1983]; Bailey, Graham, and Kaplan [1985] Morrison and Winston [1987]; Bailey and Williams [1988]; and Borenstein [1989].

TABLE V
REGRESSIONS STRATIFIED BY PRICE DIFFERENCES AMONG COMPETITORS

| | Dependent variable: LGSHARE | | | | | |
|---|---|---|---|---|---|---|
| | Small average prices differences | | Medium average price differences | | Large average price differences | |
| INTERCEPT | 0.01 | 0.02 | −0.02 | −0.02 | 0.04 | 0.07 |
| | (0.04) | (0.05) | (0.04) | (0.04) | (0.04) | (0.05) |
| APTDOM | 1.34[a] | 1.19[a] | 1.15[a] | 1.09[a] | 1.02[a] | 1.00[a] |
| | (0.24) | (0.33) | (0.25) | (0.32) | (0.29) | (0.36) |
| APT*TOUR | −3.44 | −10.11 | −10.69 | −9.76 | −25.47[b] | −23.09 |
| | (10.02) | (12.48) | (10.22) | (11.61) | (11.78) | (15.48) |
| CRS | | 0.50[c] | | 0.14 | | 0.06 |
| | | (0.27) | | (0.22) | | (0.30) |
| OAPTDOM | −1.42[a] | −1.46[a] | −0.98[a] | −1.14[a] | −1.11[a] | −1.05[b] |
| | (0.27) | (0.34) | (0.27) | (0.33) | (0.31) | (0.40) |
| OAPT*TOUR | 27.60[b] | 25.03 | 1.73 | −0.90 | 21.02[c] | 16.96 |
| | (12.16) | (15.99) | (12.90) | (14.43) | (11.95) | (13.39) |
| OCRS | | 0.09 | | 0.26 | | −0.43 |
| | | (0.32) | | (0.30) | | (0.37) |
| SCHDCONV | 0.78[a] | 0.86[a] | 0.74[a] | 0.77[a] | 0.73[b] | 0.73[c] |
| | (0.25) | (0.27) | (0.24) | (0.28) | (0.33) | (0.37) |
| OBSERVATIONS | 297 | 249 | 297 | 249 | 297 | 248 |
| $R$-SQUARED | 0.217 | 0.227 | 0.170 | 0.181 | 0.096 | 0.120 |
| $F$ RATIO | 16.09[a] | 10.10[a] | 11.88[a] | 7.58[a] | 6.16[a] | 4.69[a] |

*Note.* All variables are differenced by point of origin.
See Data Appendix description of PRICE variable for explanation of the differences in number of observations.
a. Significant at 1 percent level.
b. Significant at 5 percent level.
c. Significant at 10 percent level.

with small price differentials among competitors are those in which the observed airline's average price is within about 7 percent of the average price of all others on the route, $0.93 < PRICE/OPRICE < 1.07$. Medium price differentials are approximately from 7 percent to 18 percent and large price differentials are greater than 18 percent.

The effect of changes in airport share on route share seems to be quite consistent across the three categories. The marginal effect on route share due to airport dominance is significant even when competitors charge very different prices. These price differences between competitors are, of course, endogenous. Nonetheless, Table V indicates that in the equilibria we observe, regardless of price differences between firms, differences in route share by point of origin are strongly associated with differences in airport share.[37] This comparison does not indicate the effectiveness with which fare discounting can be used to overcome airport share advantages, but it suggests strongly that airport dominance is a significant part of airline competition even when prices among competitors differ substantially.[38]

## V. Conclusion

After controlling for price and quality differences, I have found that the dominant airline at an airport attracts a disproportionate share of the traffic that originates at the airport. This enhanced attractiveness of the dominant carrier seems to be greatest among business travelers, indicating that at least some of the advantage probably comes from frequent flyer plans. The effect of computer reservation systems seems to be small and difficult to distinguish statistically. Whether the competitive advantage of airport dominance is due primarily to marketing devices or to reputation advantages, the results presented here indicate that small-scale entry into an airport may be quite difficult, even if the entrant has lower costs than those of the incumbent.

Though the nature of the air travel product permits an innovative method of diagnosing the advantage of a large, multiproduct firm, there is no reason to believe that this advantage is unique to the airline industry. Information spillovers are present virtually anytime a company sells many related products. Market-

37. If price differences between competitors reflected merely hedonic pricing of quality differences, then the stratification in Table V would not answer the criticism explained above. Rather, one could argue that a firm without much airport share could overcome that disadvantage by dropping its price only slightly below the *quality-adjusted* competitive price that it would charge if there were no airport share advantage. The argument is difficult to support in this case, however, because the firms that are generally perceived to be high-quality, e.g., American, Delta, and United, do not systematically charge higher average prices than the airlines against which they compete in a market, while only People's Express appears to systematically charge much lower average prices (more than 10 percent lower) than the firms against which it competes.

38. The results in Table V also may give some indication that the dominant-firm advantage is more easily offset with price cuts in tourist markets than in business markets. The tourist interaction variable for the observed carrier (APT*TOUR) has the largest estimated offsetting effect when price differences between firms are large. This point cannot be pushed very far, however, both because the differences in estimates are not significant between the three groups and because the same pattern is not found for the tourist interaction variable for opposing airlines (OAPT*TOUR).

ing devices modeled after the airline FFPs and TACOs have taken hold in other travel-related service industries and seem likely to spread further.

Regardless of the source of the advantage that flows to large multiproduct firms, the result is likely to be an increase in the scale of operations necessary for a new entrant to compete effectively. This may raise the sunk costs required of an entrant and, thus, lessen the contestability of markets in an industry. It may also lower the equilibrium number of firms that will survive in an industry, thereby changing the level of actual, as well as potential, competition.

The efficiency consequences and preferred public policy responses to such outcomes depend largely on the social value of the interproduct linkages that create the advantage. If the advantage results from natural information spillovers, then the social gains from reduced information gathering time probably outweigh the possible losses from decreased competition. Such an analysis would resemble a study of natural monopoly and would, in all likelihood, come to the conclusion that prohibiting exploitation of such a natural advantage lowers net social surplus. If the advantage results from scale economies in media advertising, then the social value of the advertisements themselves must also be considered.[39]

The social value of a dominant firm advantage is more questionable when it results from marketing devices that raise switching costs, such as the FFPs and TACOs. The advantage is particularly suspect when the marketing device exploits a principal/agent relationship on the buyer's side. In such cases even the static welfare effect of an FFP-like program can be negative if, for instance, the agent's inefficient behavior causes the principal to decrease his quantity purchased.[40] If, in addition, the program insulates the incumbent from competition, then the long-run welfare effects are almost certainly undesirable. In these cases, where the large-firm advantage has neutral or negative efficiency effects in the short run and deters entry in the long run, the argument for government intervention is strongest.

39. If such advertising is thought to be mostly informative, then this is similar to other natural information spillovers. However, if such ads are meant to persuade or mislead, rather than inform, greater caution is warranted.

40. See Borenstein [1988] for a more complete discussion of the entry deterrence and welfare effects of FFPs.

## Data Appendix

The round-trip route traffic, price, and origination share data come from the Department of Transportation's (DOT's) Databank 1A (DB1A), a 10 percent sample of all tickets sold in the United States, in this case during the second quarter of 1986. As explained below, adjustment for reporting rate inconsistencies is done by comparison of DB1A reported enplanements to the enplanements reported in the DOT's T-9 Nonstop Market Data as processed by I. P. Sharp. The T-9 is not a sample, but a complete census of every flight and every passenger that enplanes and deplanes by carrier, airport, and city-pair segment.

The data on share of CRS sales by metropolitan area are taken from the data appendix to the DOT's 1988 study of the effect of CRSs. The data for construction of the schedule convenience variable are taken from the May 15, 1986, Official Airline Guide. This date is the chronological center of the second quarter of the year.

Specific variables were derived as follows:

*Route Share Variables*

$SHARE^a_{ij}$: By-origin route share. Share of round-trip tickets, $i - j - i$, sold by airline $a$, where $i$ and $j$ index airports. *Source.* DB1A as adjusted (explained below) using T-9, U. S. Department of Transportation (USDOT).

$LGSHARE^a_{ij}$:

$$LGSHARE^a_{ij} = \ln\left[\frac{SHARE^a_{ij}}{1 - SHARE^a_{ij}}\right].$$

$RUTSHARE^a_{ij}$: Route share. Carrier $a$'s share of all round-trip tickets in the $ij$ market. *Source.* DB1A as adjusted using T-9, USDOT.

*Airport Dominance Variables*

$APTDOM^a_{ij}$: The number of passengers originating any ticket at airport $i$ whose first flight segment is on airline $a$ (excluding passengers traveling on the $ij$ route) divided by the total number of passengers originating any ticket at airport $i$ (excluding passengers traveling on the $ij$ route). *Source.* DB1A as adjusted using T-9, USDOT.

$APTDOMxx{-}yy^a_{ij}$: Equals $APTDOM^a_{ij} - xx$ if $APTDOM^a_{ij}$ is greater than $xx$ percent and less than $yy$ percent, equals zero if

$APTDOM^a_{ij}$ is less than $xx$, equals $yy - xx$ if $APTDOM^a_{ij}$ is greater than $yy$.

$OAPTDOM^{-a}_{ij}$: Weighted average of $APTDOM_{ij}$ for all carriers other than $a$ that serve the observed route. Weights are the by-origin route share ($SHARE_{ij}$) of each competing carrier on the observed route (rescaled so weights add to one). *Source:* DB1A as adjusted using T-9, USDOT.

$OAPTDOMxx-yy^a_{ij}$: Equals $OAPTDOM^a_{ij} - xx$ if $OAPTDOM^a_{ij}$ is greater than $xx$ percent and less than $yy$ percent, equals zero if $OAPTDOM^a_{ij}$ is less than $xx$, equals $yy - xx$ if $OAPTDOM^a_{ij}$ is greater than $yy$.

*Tourism Related Variables*

$TOURIDX_i$: Index of the tourist orientation of the traffic served by a given airport, based on data on the metropolitan area (or county if not in an SMSA) around the airport. The numerator is the total Hotel, Motel, and Motor Hotel Revenues multiplied by the proportion of hotels in the state who reported in a 1977 survey that they serve primarily Tourist or Group/Convention business (Table 10 of 1977 Census of Service Industries). The denominator is total Personal Income in the area. If the ratio is greater than 0.07, then $TOURIDX_i = 0.07$. *Source.* Census of Service Industries [1977, 1982], State and Metropolitan Area Data Book [1982].

$TOURDUM_i$: Dummy variable designation of airport $i$ as a primarily tourist destination or not, equals one if tourist index of the airport ($TOURIDX_i$) is greater than 0.023, zero otherwise. Airports designated as primarily tourist destinations that are part of at least one route in the top 1,200 are Las Vegas, Reno, all Hawaii airports, all Florida airports except Jacksonville and Tallahassee, Billings, MT, Monterey, CA, Myrtle Beach, SC, and Caspar, WY.

$APT{*}TOUR^a_{ij}$: $APTDOM^a_{ij}$ multiplied by $TOURIDX_j$.

$OAPT{*}TOUR^{-a}_{ij}$: $OAPTDOM^{-a}_{ij}$ multiplied by $TOURIDX_j$.

$APT{*}TDUM^a_{ij}$: $APTDOM^a_{ij}$ multiplied by $TOURDUM_j$.

$OAPT{*}TDUM^{-a}_{ij}$: $OAPTDOM^{-a}_{ij}$ multiplied by $TOURDUM_j$.

*Computer Reservation System Variables*

$CRS^a_i$: The share of computer reservation system revenues in the metropolitan area of airport $i$ that are generated on the CRS owned by airline $a$, equals zero if the observed airline did not own a CRS in 1986. *Source:* USDOT [1988].

$OCRS_{ij}^{-a}$: Weighted average of $CRS_i$ for all carriers other than $a$ that serve the observed route. Weights are the by-origin route share ($SHARE_{ij}$) of each competing carrier on the observed route (rescaled so weights add to one). *Source:* USDOT [1988] and DB1A as adjusted using T-9, USDOT.

*Schedule Convenience Variables*

$SCHDCONV_{ij}^{a}$ : A carrier's share of the conveniently scheduled nonstop flights for round-trip travel between airports $i$ and $j$ of the type $i - j - i$. Conveniently scheduled flights are those on weekdays that leave to fly $i - j$ between 6 A.M. and 10 A.M. plus those that leave to fly $j$-$i$ between 4 P.M. and 8 P.M. If there were no conveniently scheduled flights for $ij$ or no conveniently scheduled flights for $ji$, then $SCHDCONV_{ij}^{a}$ or $SCHDCONV_{ji}^{a}$ were undefined. In that case, $SCHDCONV_{ij}$ and $SCHDCONV_{ji}$ were set to missing values and the difference between them was set to zero for all carriers on the route. *Source:* Official Airline Guide, May 15, 1986.

*Price Variables*

$PRICE_{ij}^{a}$: Average price charged by carrier $a$ for round-trip travel on route $ij$. *Source:* DB1A as adjusted using T-9, USDOT. Data analysis that used price variables excluded all observations on routes on which Alaska Airlines carried more than 1 percent of the traffic (Alaska Airlines systematically reported incorrect prices) and all observations on which the observed carrier's average price for round-trip travel from point $i$ was more than twice the carrier's average price for round-trip travel from point $j$.

$OPRICE_{ij}^{-a}$: Weighted average of $PRICE_{ij}$ for all carriers other than $a$ that serve the observed route. Weights are the by-origin route share ($SHARE_{ij}$) of each competing carrier on the observed route (rescaled so weights add to one). *Source:* DB1A as adjusted using T-9, USDOT.

*Explanation of Reporting Rate Adjustment.* Though the DB1A is supposed to be a 10 percent sample of all tickets sold by a carrier, reporting rates are not consistently 10 percent. The T-9 Nonstop Data Set, however, allows for some correction when inconsistencies are found. The T-9 is a complete census of passengers on every flight segment of every airline. Thus, the number of people reported in the DB1A to be boarding flights at a given airport by a given airline should be 10 percent of the T-9 census figure. If the DB1A figure is not 10 percent of the figure calculated from the T-9, then every report of passengers originating at the airport is adjusted by the proportion of the DB1A to the T-9 figure.

For example, assume that the T-9 reports that 750,000 passengers boarded United flights at O'Hare airport during the quarter, but only 50,000 passenger tickets with O'Hare boardings on United were reported in the DB1A. Full 10 percent reporting would show 75,000 of these tickets in the DB1A.[41] To correct for this error, every count of passengers on a given itinerary/fare combination that appears in the DB1A and originates at O'Hare is scaled up by 75,000/50,000 or a factor of 1.5.[42]

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41. This assumes that the T-9 is accurate. Because it is a simple head count of boardings and passengers on board, it is generally considered to be a very reliable report.

42. This process closely mimics the one used by Boeing Computer Services in their adjustment of passenger counts for reporting rate inconsistencies. Though I have not carried out the statistical analysis reported in this paper on unadjusted data, the same pattern of asymmetric route shares by point of origin and its relationship to airport dominance is evident in the unadjusted data.

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