Hub and Network Pricing in the Northwest Airlines Domestic System

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Executive Summary of This Study

1. This paper investigates the “hub premium” hypothesis that major carriers with the major share of traffic in and out of a hub exploit so-called "monopoly power." The hypothesis states that these carriers charge hub-city residents higher fares for travel originating or terminating at the hub than they charge other passengers traveling on the rest of their systems. Some have even gone so far as to claim that consumers living in hub cities live in “pockets of pain.”

2. By contrast, virtually everyone agrees that consumers who choose to take one stop flights enjoy the full benefits of competition. If a passenger is traveling, say, from Newark to Los Angeles or Seattle and is willing to include a stop in the itinerary, that person has a choice of flying perhaps seven or eight different airlines – including all of the major carriers. Those flying shorter distances, even from Washington to Chicago, have the choice of connecting through cities like Cleveland, Pittsburgh, Detroit, and Cincinnati, rather than going nonstop. This rich array of choices for connecting traffic guarantees a competitive fare to the passenger willing to make a connection.

3. The surprising result of this study is that the passenger originating or terminating his or her trip in the three major Northwest Airlines hub cities actually enjoys the same competitive fare as the connecting passenger, holding constant the effect of mileage on fares. And yet this study makes no adjustment whatsoever to the benefit to the hub-originating passenger of his or her freedom from the inconvenience or time penalty of connecting or stopping enroute.

4. Because hub-originating passengers on the Northwest Airlines system pay no more than the fares paid by connecting passengers through those hubs, they enjoy a very substantial benefit of the time and convenience saving of being able to fly nonstop to many destinations from the hub rather than being forced to connect to obtain lower fares.

5. Those passengers originating or terminating their travel in a Northwest hub receive a travel bargain compared to other passengers on Northwest airlines. Hub-originating passengers receive a higher quality product, since they have the option of flying directly to many destinations without stopping or connecting, yet our study shows that they do not pay a higher fare for this privilege. In fact, they pay *slightly less* on nonstop hub-originating flights than passengers pay to connect on a route of given mileage and with given advance purchase and minimum-stay restrictions.

6. Average fares paid at any airport are misleading. Only a few passengers pay high walk-up fares. At Minneapolis in 1998 fully 77 percent of Northwest passengers originating their travel at that hub paid less than the average fare.

7. There is a higher percentage of passengers paying unrestricted fares at the Northwest hubs, but this is not because discount fares at the hubs are unavailable. In September, 1999, 86 percent of discount fares in the top 30 Northwest hub-originating markets from Minneapolis were available 30 days in advance.

8. This study is the first to be based on proprietary airline data. Because of its rich data source, it is also the first to base its study of the relationship between fares and mileage for hub-originating and connecting traffic on detailed data by fare category.

9. This study, because of its unique data source, is able to correct for many of the flaws in previous studies based on data collected at a high level of aggregation. For instance, in addition to its careful controls for elapsed mileage on every route and for the travel conditions and restrictions of each type of ticket, this study is able to strip out the effect of connections between regional airlines and the hub airline and is also able to incorporate the value of frequent flyer awards.

Airline Competition, Hub Premiums, and the Scope of this Study

Since deregulation more than 20 years ago, the U. S. airline industry has provided enormous benefits to business and leisure travelers. Traffic on U. S. scheduled airlines has more than doubled from 1979 to 1998. The average fare paid has fallen by fully forty percent when adjusted for economywide inflation. Despite finally returning to profitability in the past four years, U. S. scheduled airlines have barely broken even over the past decade, with an average ratio of net profits to total revenue of just two-tenths of one percent, the lowest of any industry in the American economy. In effect, the benefits of growing traffic and falling prices to U. S. consumers and the business community have been heavily subsidized by airline stockholders.

Despite this record, airlines have been severely criticized in recent years. Fusillades of criticism have targeted the major U. S. airlines for fares that are claimed to be outrageously high, "fortress hubs" that are alleged to exploit local residents, and "predatory" practices that are claimed to drive new startup airlines out of business and prevent them from making low fares available to the traveling public. The U. S. Department of Transportation has proposed to implement an anti-competition policy to regulate the allowable responses of established carriers to competition from new start-up airlines, and civic groups in many of the hub cities continue to protest that carriers discriminate against hub residents in favor of other passengers using their systems.

This study limits its attention to one of several aspects of the current debate about the domestic air transportation system, namely the fare differential alleged to be paid by residents of airline hubs, particularly "fortress hubs" dominated by a single carrier. This differential, hereafter described by its oft-used label "hub premium," is claimed to be particularly large at the three major hubs of Northwest Airlines.

Thus we are fortunate that Northwest Airlines has been willing to provide us with a complete data set of its prices for the years 1996-98, allowing us to conduct a careful analysis of fares paid by individual fare category by travelers originating their travel at one of the Northwest hubs in comparison with travelers originating their travel in other cities and making connections to a destination beyond the hub. The aim of the study is to determine whether travelers departing from one of Northwest's three hubs and flying a trip of a given distance pay more than those flying through the hub enroute elsewhere. The hypothesis that there is a substantial hub premium predicts that there is a substantial fare differential paid by travelers whose trip starts or ends at a Northwest hub. In short, our study is the first, using proprietary airline data, which measures the extent to which hub residents are "captive victims" of price-gouging by the dominant hub carrier where they live.

An important point of departure for this study is that the natural comparison to determine the existence of a hub premium is between fares on traffic originating in hubs and traffic (corrected for distance) connecting through hubs. Taking connecting traffic as the basis for the comparison with hub-originating traffic seems uncontroversial. Virtually everyone agrees that consumers who choose to take one stop flights enjoy the full benefits of competition. If a passenger is traveling, say, from

Newark to Los Angeles or Seattle and is willing to include a stop in the itinerary, that person has a choice of flying perhaps seven or eight different airlines – including all of the major carriers. Those flying shorter distances, even from Washington to Chicago, have the choice of connecting through cities like Cleveland, Pittsburgh, Detroit, and Cincinnati, rather than going nonstop. This rich array of choices for connecting traffic guarantees a competitive fare to the passenger willing to make a connection. Government evaluations of deregulation call attention to the higher level of competition made possible by the availability of multiple hub routings for flights between medium-sized and smaller cities through alternative hubs.[1]

It is important to differentiate this study from several in the previous literature on airline pricing during the post-deregulation era. This study is based just on Northwest passengers and makes no comparison between fares paid on a given route by passengers flying Northwest and flying other airlines. While this limitation narrows the scope of the study, it is offset by the advantage of using proprietary fare data that is more detailed than fare data used by previous studies of the entire domestic U. S. airline system. However, it should be clear that this study intends no implication that its findings extend to other major U. S. hub airports beyond the three Northwest hubs studied here. In particular, it is widely recognized that airfares tend to be lower in cities where Southwest Airlines has a major presence, and Southwest serves only one of the three Northwest hub cities (Detroit).

Airline Pricing Since Deregulation

Because air fares in 1978 were distorted by tight government regulation, long-haul fares tended to be too high in relation to airline costs and short-haul fares tended to be too low. This occurred because government regulation had started out with a pricing structure that was close to a fixed price per mile. In the 1960s a 200-mile flight might cost $15 one way and a 2000-mile flight might cost $150 one-way. Yet a greatly disproportionate share of airline costs are incurred not in proportion to mileage flown but in proportion to the number of take-offs and landings, not just because speeds are slower and fuel usage greater during the take-off and landing phase of a flight, but because many types of airline costs (check-in agents, baggage handlers, aircraft servicing) rise in proportion to passenger enplanements rather than distance flown. Thus airlines typically made money on long-haul flights and cross-subsidized money-losing short-haul flights.

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1. "In addition, the established airlines' transition to hub-and-spoke systems following deregulation has increased competition at many airports serving small and medium-sized communities. By bringing passengers from multiple origins (the spokes) to a common point (the hub) and placing them on new flights to their ultimate destinations, these systems provide for more frequent flights and more travel options than did the direct "point-to-point" systems that predominated before deregualtion. Thus, instead of having a choice of a few direct flights between their community and a final destination, travelers departing from a small community might now choose from among many flights by several airlines through different hubs to that destinations." See *Domestic Aviation: Changes in Airfars, Service, and Safety Since Airline Deregulation* (Testimony, 04/25/96, GAO/T-RCED-96-126).

Accordingly, when airlines were free to set their own fares, they aligned prices more closely with costs, and short-haul fares went up relative to long-haul fares. Still, taking all fares together, average air fares went up between 1978 and 1998 by just 60 percent, far less than the 150 percent increase in the CPI, so that the inflation-adjusted fare fell by 34 percent.[2] Much of the current grumbling about air fares reflects the fact that people wind up paying different prices for the same seat. Business travelers who change plans at the last minute — yet have no option but to make the trip — pay a relatively high fare, while leisure passengers who have the alternative of driving or not traveling at all are willing to pay only a much lower fare. Economists showed long ago that this so-called "multi-part pricing" actually improves economic efficiency, since each traveler pays a price closer to what they think their own trip is worth.

Millions of leisure passengers are able to make trips that they otherwise could not afford because some last-minute business travelers pay the higher price that the trip is worth to them and their companies. A return to government regulation that forced airlines to charge everyone the same fare would sell air travel to last-minute business fliers for much less than it is worth to them, while depriving leisure passengers the opportunity to take trips at the lower prices that they can afford to pay. As a result of cheap leisure air fares, the volume of air travel has exploded since deregulation. Revenue passenger miles flown by scheduled U. S. air carriers have increased since 1978 by 136 percent, more than double the 61 percent increase in real Gross Domestic Product over the same interval.[3]

Review of the Literature

In this brief review of the literature we focus on three studies that reach contradictory conclusions. Two studies by Borenstein (1989, 1999) find significant hub premiums, while a study by Morrison and Winston (1995) does not.[4] Much of the essence of our subsequent findings is related to the adjustments that Morrison and Winston make, but Borenstein does not, that eliminate

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2. The average passenger yield (including domestic and international) was 8.19 cents in 1978 (1982 and 1985 *Statistical Abstract of the United States)* and 13.1 cents in 1998 (*Air Transportation Association 1999 Annual Report)*.

3. Domestic and international RPMs for 1998 from the *ATA 1999 Annual Report*, linked to 1978 using the 1982 and 1985 *Statistical Abstract of the United States.*

4. Hereafter each study is identified by author and year of publication. The full citations are Severin Borenstein, "Hubs and high fares: dominance and market power in the U. S. airline industry," *RAND Journal of Economics*, vol. 20, no. 3, Autumn 1989, pp. 344-65; Severin Borenstein, "Hub Dominance and Pricing," unpublished working paper dated January 21, 1999; Steven A. Morrison and Clifford Winston, *The Evolution of the Airline Industry* (Washington: Brookings Institution, 1995).

the superficial appearance of a hub premium.

Among the studies which we do not review in detail is by the General Accounting Office in 1990, which concluded that the average fare per mile for trips originating at fifteen hub airports dominated by one or two carriers was 27 percent higher than the average price at 38 unconcentrated airports used as a control group. This study made no attempt to control for route distance, number of plane changes, traffic mix, carrier identify, or the role of frequent flyer tickets, and so it is not discussed further here.[5]

The 1989 Borenstein study is a major article in a highly respected academic journal that specializes in the economics sub-field of "industrial organization." Borenstein's paper is wide in scope, treating numerous aspects of airline competition. Among his conclusions are that "dominance of major airports by one or two carriers, in many cases the result of hub formation, appears to result in higher fares for consumers who want to fly to or from these airports . . . such strongholds seem to insulate the dominant carrier from competition." He distinguishes between route dominance and hub dominance; route dominance is the share of a carrier at the two endpoints of a given route. Hub dominance is the share of a carrier at a given airport.

Borenstein distinguishes between two sources of market power of airlines with route dominance or hub dominance, first "competitive advantages that occur naturally" and "those that result from institutions created by airlines." The first set of advantages is the attraction to passengers of an airline that operates the most flights on a given route. This "natural" advantage of a dominant carrier is familiar from the pre-1978 regulated era, when carriers battled to establish an advantage in offering the most frequencies on a given route to obtain the well-documented "S-curve" benefit that passengers and revenue on a route increase disproportionately for the carrier offering the most flights on a route.

The second class of advantages is treated by Borenstein as artificial, although he does not use that word. These include frequent-flyer programs, overrides paid to travel agents which book more than a threshold number or percentage of passengers on a particular airline, and a stranglehold on gates and other airport facilities.

Borenstein's paper begins with some "raw" data that are relevant to the current debate over hub premiums. He displays average fares by mileage class for all domestic flights and for six large airline hubs. Compared to the domestic system average for the 1000-1500 mileage class, he finds that prices on flights to/from these hubs are 28.7 percent higher for TWA at St. Louis, 21.8 percent higher for Northwest at Minneapolis, 16.1 percent higher for US Airways at Pittsburgh, 35.6 percent higher for American at Dallas/Ft. Worth, 21.5 percent higher for Delta at Atlanta, and 19.4 percent *lower*

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5. General Accounting Office, *Airline Competition: Higher Fares and Reduced Competititon at Concentrated Airports,* GAO/RCED 90-102 (July, 1990).

for United at Chicago O'Hare.

Borenstein's empirical work includes two types of equations in which the average price on a particular city-pair route is the dependent variable. The first type of equation regresses the route price in the third quarter of 1987 on distance, load factor, average aircraft size on a given route, frequency of flights, circuitry of mileage actually flown by connecting passengers relative to the nonstop mileage on a particular route, number of stops, number of plane changes, weighted average cost for a standardized distance of other carriers on the given route, tourism index for each endpoint of a route, and four other variables intended to measure the effects of competition or lack thereof. The five competition variables are the observed carrier's average share of passenger originations at the two endpoints of the route, the average Herfindahl index for passenger originations at the two endpoints of the route, the carrier's share of all local origin-to-destination passengers on the observed route, a Herfindahl index for the route, and a dummy variable for 22 specific airports if they are at either end of the route.

Borenstein's complex framework does not yield any results that are directly relevant for the debate over hub premiums. While several of the coefficients on his competition variables are significantly positive, he does not attempt to focus his results on the issue of hub premiums. For instance, he finds that the origin share variable representing the share at the endpoints adds between 3 and 25 percent to the price, depending on which of nine different equations is used, and that the share of O&D traffic on the route adds another 3 to 12 percent. These results tell us nothing about hub premiums but are consistent with the hypothesis that travelers pay more to fly carriers that have more frequent service on a given route. For instance, TWA's average ticket price on the JFK-LAX route was 38 percent below American's average ticket price during the year 1998, but this tells us nothing about hub premiums since neither JFK nor LAX are hubs in the usual sense of the word, and this differential could reflect the preference of business travelers for American's much more frequent service, its three-class transcontinental product which includes sleeper seats in first class, or numerous other service differences between TWA and American.[6]

Borenstein's second set of "relative price" regressions regress the *price differential* between the dominant carrier on a route and the second carrier on those factors that differ among the two carriers, holding other route-specific variables fixed. This reduces the number of explanatory variables from 14 to 8. The results are consistent with the basic equation but are less significant statistically.

Overall, the 1989 Borenstein study accomplishes little more than supporting the old pre-deregulation "S-curve" hypothesis that the dominant carrier on the route will attract both more traffic and more high-yielding business traffic. The fact that business travelers choose voluntarily to tilt their

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6. Source of fare differential ($365 one-way ticket price on American, $229 on TWA): *Paine-Webber the Airline Database Full-year 1998 Edition.*

business to the carrier offering the majority of seats on a given route does not provide any evidence on issues involving airline competition; it simply reinforces the common sense that time-sensitive business travelers favor the airline that they believe is most likely to have a departure time closest to their desired time of departure.

Compared to the complexity and ambiguity of the 1989 study, the new 1999 Borenstein paper is clear and simple. No regressions are estimated. Prices charged for origin-to-destination trips to and from a given airport are averaged for both legs of a round trip and compared with national average prices for trips in each 50-mile mileage category, e.g., 550-600 miles. Then the premium for flights to and from a given airport are averaged over the various distance categories. It is unclear from the appendix description in the paper whether the aggregation over the different mileage categories is based on revenue, revenue-passenger miles, or passengers.

The results are presented for the fourteen years between 1984 and 1997, and 50 airports are included. Airport differentials in 1997 range from 55 percent for Charlotte to -33 percent for Dallas Love Field. Differentials for Northwest's hubs are 13 percent for Detroit, 37 percent for Minneapolis, and 35 percent for Memphis. A separate table redoes the calculations for individual airlines at 18 major hub airports, and the Northwest results are 22 percent at Detroit, 41 percent at Minneapolis, and 39 percent at Memphis. With regard to these results, it is important to note that no variable is held constant except for mileage. None of the complex distinctions in Borenstein's earlier studies are taken into account. In particular, no account is taken of the lower value of connecting flights compared to nonstops, and no attempt is made (in either Borenstein study) to control for the mix of business and leisure traffic or for the role of frequent-flyer award tickets.[7]

The final study that we review here, a section of the Morrison-Winston book on post-deregulation airline competition, arrives at quite different conclusions from the two Borenstein studies. A valuable contribution is to identify variables that are relevant to the issue of hub premiums. The first of these, distance, is taken into account in both Borenstein studies and turns out to be extremely important in the current report. However, it is worth quoting the Morrison-Winston explanation of the other variables that must be taken into account in assessing hub premiums. These are the number of connections, the mix of full-fare business tickets as contrasted with restricted leisure tickets, carrier identity, and the role of frequent flyer tickets:

> "Trips requiring a change of planes have lower fares than single-plane flights because passengers consider changing planes less desirable than taking a nonstop flight. Again, because hubs have a greater proportion of nonstop flights than nonhubs, not correcting for

7. In Borenstein (1989) there is a "tourist" variable which differentiates leisure oriented destinations like Phoenix and Las Vegas from others. But personal and leisure travel to visit friends and relatives can be to any destination, from Fargo to Boston. Only by collecting data by fare class can we begin to distinguish leisure from business travel, as is done in this study.

> plane changes would also make the fare premium for flights out of hubs appear larger than it is. The mix of fares must be taken into account because a larger proportion of full-fare tickets relative to discount tickets at a given airport would affect yield comparisons. Carrier identity must be considered: a carrier might charge high fares at a hub (Delta at Atlanta, for instance) because it charges high fares at all the airports it serves. Finally, because yields are higher on routes with more frequent fliers, it is necessary to include in the yield calculation the passengers who fly free because they are using their frequent flier awards. Frequent fliers are also liekly to constitute a larger share of passengers at hub airports, so excluding them from the analysis would inappropriately inflate hub yields relative to nonhub yields."[8]

The Morrison-Winston study differs in several respects from the two Borenstein studies. They excluded eleven airports located in Florida, Arizona, California, and Nevada "that were likely to have a greater proportion of tourist traffic than the conentrated airports." This exclusion replicates the role of the Borenstein "tourist" variable in the 1989 study and also tends to reduce the role of airports dominated by Southwest airlines in pulling down the national average of airline fares.

Similar to Borenstein's control for mileage in 50-mile groups, the Morrison-Winston study controls for distance in 100-mile bands. Unlike the 1999 Borenstein study, Morrison-Winston also control for number of plane changes (zero or one), and the identity of each carrier. Also differing from Borenstein, frequent flyer tickets are included. The study covers the fourth quarter of 1978 through the fourth quarter of 1993 and explicitly estimates the differences between the raw unadjusted fares collected by the GAO study (cited above) and the adjusted results taking into account distance, connections, frequent flyer tickets, and carrier identity.

Morrison and Winston make a particularly strong case that frequent flyer tickets must be included in the data base (contradicting Borenstein), because a rational consumer could choose to pay more to fly a major carrier if that consumer believed that the higher ticket price would be offset by the value of free tickets at some points in the future. Recently the importance of the Morrison-Winston finding has been underlined in a a pathbreaking new carried out by the *Consumer Reports Travel Letter* of DoT data. According to these new results, the percentage of available seats allocated to frequent flyer awards is much higher than most observers would have guessed, 9.1 percent in the case of Northwest Airlines in 1998.[9]

The overall result of the Morrison-Winston study is that the unadjusted hub premium in 1993 for 15 concentrated airports using the GAO methodology was 33.4 percent. The Morrison-Winston

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8. Morrison and Winston (1995), pp. 46-47.

9. Note that this percentage is a fraction of seats, not passengers. Since Northwest's system load factor in the year 1998 was 73.1 percent, this implies that 9.1/.731 or 12.4 percent of Northwest's passengers in 1998 were flying on award tickets. The source is "Your Odds of Landing a Free Seat to Paradise," *Consumer Reports Travel Letter*, June 1999, pp. 7-13.

corrections provide an alternative and much smaller estimate of 5.2 percent, a difference of 28.2 percent. The most important factors contributing to this different conclusion are the more sophisticated corrections for distance and the number of plane changes (18.6 points of the difference), carrier-specific comparisons (4.6 percentage points), and including frequent flyer awards (2.5 points of the difference).

Morrison and Winston conclude this section of their study by stating "The hub premium is so small, relative to the fare reductions from deregulation, that travelers to and from concentrated hubs still pay less than they would have under regulation" (p. 49).

This Study: Scope and Method

As stated in the introduction, this study is the first to use proprietary internal airline data to assess the "hub premium" hypothesis that airline passengers originating or terminating their travel in a hub dominated by a single carrier pay substantially higher fares than passengers whose travel originates or terminates in non-hub airports. Because our data refer only to Northwest Airlines, we can only determine whether a hub premium exists within the Northwest domestic system and not whether Northwest charges a lower or higher fare on a given route than some other airline.

Are Northwest prices typical among major domestic airlines? As we already know from the previous literature, any comparison of Northwest's prices must be made with other airlines which fly a comparable trip length. Fortunately, Northwest's average domestic trip length of 878 miles in 1998 was almost identical with the industry average of 865 miles for the ten major carriers, and its average ticket price of $119 was also identical to the industry average fare of $119, a finding that may seem surprising because this industry average includes Southwest Airlines. Northwest's average passenger ticket price per mile ("yield") of 13.60 cents in 1998 was actually *lower* than the industry average of 13.75 cents and lower also than the 13.74 cent domestic yield of TWA, the airline that has the closest trip length to that of Northwest (882 miles for TWA vs. 878 for Northwest).

Thus it is of considerable interest to study Northwest's own pricing data to learn whether it extracts a hub premium from passengers starting or stopping their travel at one of Northwest's three domestic hubs — Detroit, Minneapolis, and Memphis. This study proceeds step-by-step to compare hub-originating air fares with those of all the remaining Northwest passengers who pass through a hub en route somewhere else.[10]

Our first step will be to compare raw fares among the three hubs and non-hub routes,

10. Northwest has very few point-to-point domestic routes which do not pass through one or two of the three hubs. In order of 1998 revenue, the four largest are Seattle-Honolulu, Boston-Seattle, Honolulu-Los Angeles, and Honolulu-San Francisco.

unadjusted for mileage or fare category. The next step is to exhibit fares by fare category, distinguishing between unrestricted business fares and various types of other fare categories. The final step will be to adjust fares within each category by mileage in order to determine whether hub-originating passengers pay more for a trip of given distance.

Compared to the previous literature, our study differs most obviously by studying a single airline, albeit an airline with an average price and average trip length remarkably close to the domestic industry average. We share in common with the Morrison-Winston study three basic similarities — correcting for distance, including frequent-flyer award tickets, and by distinguishing between full-fare business fares and other fares.

We differ from the Morrison-Winston study in that we do not make any adjustment for the inferior quality of travel that involves connections through hubs in comparison with nonstop travel originating in a hub. This reflects two limitations in our data. First, much of the connecting travel through hubs on the Northwest domestic system does not represent an inferior quality of product, simply because on many of these routes, e.g., Grand Rapids to Los Angeles, no nonstop service is available on any airline, yet we are unable to divide our data between connecting routes that have nonstop competition and those that lack such nonstop competition. Another data limitation is that some hub-originating travel in the Northwest system is not nonstop but rather involves a connection at a second hub, e.g., Minneapolis-Detroit-Providence or Detroit-Minneapolis-Sacramento. We know that this second limitation is relatively unimportant, simply because flights among the three hubs represent only a small fraction of Northwest domestic traffic, less than 5 percent.

This data limitation, that we cannot identify which nonhub passengers are connecting when they have nonstop options on other carriers, and which hub-originating passengers are connecting, creates an inherent bias in our study in favor of the hub-premium hypothesis. Thus if we find that hub-originating and nonhub passengers pay the same fares, corrected for distance and fare category, then we know that the true hub differential *is a discount rather than a premium.* Why? This occurs simply because a hypothetical finding that the hub premium is zero would disguise the fact that the hub-originating customer is flying nonstop in almost all cases, whereas many nonhub passengers are connecting and thus would be paying the same for an inferior product.

A critical aspect of our study is that we compare hub-originating and nonhub prices not for all air fares, as does Borenstein, but by a method which separates out business-oriented full fares from other groupings of fares, as do Morrison and Winston. Our method of grouping fares is discussed below. We shall also examine data that show that, while hub-originating passengers make greater use of full-fares than non-hub passengers, they face the same extremely high percentage of discount fares which are available for purchase at the cutoff date for advance purchase restrictions.

Decomposing the Data into Fare Groups

The data used in this study were obtained from Northwest Airlines archive tapes that list the number and price of tickets sold by Origin-Destination (O&D) city-pair and by fare category. The small number of Northwest nonstop routes that do not go through any of the three hubs (e.g., west coast - Honolulu) was excluded. Passengers arriving at hubs on flights of Northwest commuter affiliates and then transferring to Northwest jet flights are treated as hub-originating passengers, and total revenue on the commuter and Northwest jet portions are prorated by the procedure described in the Data Appendix. All data presented in the tables and figures in this study are averages for the three years 1996-98; showing each year separately would expand the size of the study excessively and would have no purpose, since there are no trends or changes in the basic patterns across the three years.

The raw data yield the average prices shown in Figure 1 for the three hubs and for the Northwest domestic system. Fares in Minneapolis are considerably higher than in the other two hubs or than the system average. This could occur because of a hub premium, or because of a different mix of business and leisure traffic, or because the average departure from Minneapolis is flown over a longer distance than from the other two hubs.

As shown in Table 1, our data decompose total traffic, by hub and by nonstop vs. connection, into 13 fare categories. To avoid drowning in data, we have aggregated the 13 fare categories into three groups, and all of our subsequent analysis is carried out on these three groups. The three correspond roughly to published full-fare, unpublished full-fare (i.e., corporate and meeting fares), and all discount fares excluding award travel. Another way to characterize the groups is that Groups 1 and 2 include unrestricted fares while Group 3 consists of restricted fares.

A 14th category, award travel, has been prorated to the other classes in proportion to their share of revenue-passenger miles (RPM), on the simple presumption that earned awards are proportional to miles flown.[11] Thus the two fare categories in Group 1, shown in the first column, comprise 11 percent of RPM's for system nonstop travel, and so 11 percent of the RPMs flown in award travel is added to Group 1. Two aggregates for Group 1 are shown on the third and fourth lines of Table 1 — "Total Group 1" (e.g., $400 in the first group for system nonstop), and "Adjusted

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11. This ignores several subtleties. First, bonus miles count toward earned awards, and bonus miles are more likely to be earned by frequent travelers paying higher fares. An offsetting factor is that frequent travelers may spend more of their miles on upgrades (which do not affect our data) rather than earned awards. A final factor is that mileage toward earned awards can be earned not just by accruing RPMs on Northwest, but on its partners (e.g., KLM) or by spending on a credit card. We do not attempt to conjecture whether our arbitrary allocation of earned award travel proportionately to the RPMs flown within each fare group creates a bias; if it does, the bias is probably to understate the fraction of earned awards that come from high-fare travel, in which case our method overstates the adjusted Group 1 fares and thus the hub premium attributable to the higher use of high fares in hub-originating traffic.

Group 1" (e.g., $381, which is $400 divided by 1.05, where the .05 comes from the share of earned awards in the system nonstop category).

Comparison by Fare Category

Before comparing average fares for the connecting and nonstop traffic, we notice a consistent difference in the composition of traffic among the three fare groups. For the system and each hub, there is a higher percentage of traffic flown in the higher-fare unrestricted categories (Groups 1 and 2) for hub-originating nonstop traffic than for traffic connecting through hubs. This contrast is summarized in Table 2.

The data presented in Table 1 can be summarized by the group averages shown in the table itself, in the totals shown in the last row, or in Figures 1A-1D. Figure 1A, corresponding to the final row in Table 1, shows consistently that for the system and each of the three hubs, average fares are higher for connecting traffic than for nonstop traffic originating (or terminating) at the hubs. This occurs despite the higher fraction of nonstop traffic in the two higher-fare groups. The same excess of connecting fares over nonstop fares is shown for each of the three fare groups in Figures 1B-1D. In every case, whether for the system or each of the three hubs, the connecting fare is higher than the nonstop fare.

The same result can be seen in a different way in Table 3, which shows the *ratio* of nonstop to connecting fares not only for the total and the three groups but also for the 13 individual fare categories. The ratio is uniformly below 100 percent with one exception (corporate fares in Minneapolis), indicating that within each fare category the nonstop hub-originating fare is lower, not higher, than the equivalent fare connecting through hubs.

However, there is an obvious reason why these fare comparisons make the nonstop appear to be cheaper than the connecting routings, and this is the simple fact that elapsed mileage is longer on average for connecting flights than for nonstop flights. This difference is evident in Table 4, which shows that the average connecting trip has an elapsed mileage of 1383 miles, compared with the average nonstop mileage of 993 miles. The shorter distance of nonstop flights is particularly obvious for Minneapolis, where the longest nonstop flight is to San Francisco (1589 miles), whereas the longest connecting distance is much further, from Boston to San Francisco (2713 miles).

Correcting for Mileage Differences

We use simple regression methods comparing the average fare per 100 mile block of traffic going into the hub versus traffic going through the hub. We use the linear mileage between two points for connecting traffic. It is not reasonable to expect that consumers would wish to pay more

for connections. What they will pay for is the ability to fly from one point to another. Usage of the itinerary mileage is of no significance as travelers have no incentive to pay for a circuitous routing. This also avoids some of the problems associated with the GAO studies where certain cities are omitted from the analysis due to the contention that they are leisure destinations. Here we treat all destinations equally.

To determine the influence of mileage on fares, we have estimated simple univariate regressions of the fares against mileage, where mileage is the predictor variable. Regressions using raw data showed high R-Squares and p values, but an analysis of the residuals showed significant departures from normality. This was corrected using a double log transformation of the mileage and fare values. The regression equations were rerun using natural logarithms, and the plots of the residuals showed only random deviations from normality.
Thus the regression model we use is of the form:

$$Ln(Price) = Constant + Ln(Mileage)$$

The fitted regression slopes are computed separately for each of the three fare class groups and for connect versus nonstop traffic. Figures 4 through 6 display the fitted regression lines. For Group 1 the lines cross, indicating that nonstop fares are higher at shorter distances but lower at longer distances. For Group 2 the lines also cross but in the opposite direction, indicating that nonstop fares are higher at all but the shortest distances. For Group 3, the lines do not cross, indicating that connect fares are higher than nonstop fares for all distances.

Calculating the Hub Premium

Since the regression results point in different directions for each of the three fare groups, a method must be devised to weight them together in order to arrive at an overall hub premium. Table 5 provides several alternative weightings, all of which arrive at the same conclusion: *there is no hub premium at all, and instead there is a hub discount in the range of -4.3 to -5.0 percent.*

In developing Table 5, we started with the fitted fares by mileage class, as shown in Figures 4 through 6. Then we calculated the percentage difference between the regression lines for each mileage block, calculated as the percentage difference between the nonstop fare and the connecting fare for each block. Thus a positive percentage indicates a premium for hub-originating nonstop traffic, whereas a negative percentage indicates a hub discount.

Line 1 of the table shows the small hub premiums for Groups 1 and 2 and the hub discount for Group 3.[12] Weighting these three percentages by the share of RPMs in each fare Group

12. These are the average percentage differentials between the nonstop regression line and the connecting

(continued...)

(combining hub and connect traffic to form the weights) yields the overall hub discount shown in the final column, -4.7 percent. Alternatively line 2 uses passenger weights rather than RPM weights to place more importance on Groups 1 and 2, which have slightly shorter distances, and the hub discount declines slightly to -4.3 percent. Lines 3 and 4 replace the percentage differentials averaged across mileage blocks with average revenue across mileage blocks (which gives more weight to longer hauls), and here the hub discount emerges as -5.0 percent in line 3 and -4.6 percent in line 4.

Interpretation of the Traffic Mix at Hubs

Since we find that there is a hub discount, why have some previous investigators (like Borenstein, 1999) found a hub premium? Part of the answer is simply that, as shown in Table 2, a greater fraction of nonstop travel uses unrestricted fares rather than restricted fares, e.g., 20 percent of systemwide nonstop travel uses Group 1 and Group 2 fares while only 10 percent of systemwide connect travel uses these unrestricted fares. The importance of this factor is shown in the last two lines of Table 5. We calculated the average nonstop fare for nonstop and connect travel, taking the average mileage-corrected fares for each type of travel and each fare group and aggregating using the actual weights on the three fare groups, i.e., a higher weight on the higher-fare groups for nonstop than connect traffic.

The average mileage-corrected fare for nonstop travel ($225) is higher than the average mileage-corrected fare for connecting travel ($208) by a differential of 8.3 percent, and this is shown on line 5 of Table 5. If alternatively we weight the average nonstop mileage-corrected fare by the weights on the three fare groups of connecting travel, then the average mileage-corrected fare for nonstop travel falls to $199, and the hub discount is -4.3 percent, almost precisely what we found in lines 1 through 4 of the table.

Our treatment of the three fare groups separately is consistent with that of Morrison and Winston's separate adjustment for the fraction of business travel and conflicts with the approach of Borenstein who makes no such adjustment. Thus the issue of the hub premium turns partly on the question of why nonstop hub-originating travelers use unrestricted fares for roughly 20 percent of their travel on Northwest, while connecting passengers use these higher fares for only 10 percent of their travel.

One hypothesis is that monopolistic pricing practices by Northwest block passengers from obtaining the listed discount advance-purchase fares from hubs while making them freely available

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12. (...continued)
regression line in each 100-mile category, giving equal weights to each 100-mile block. In the final version of the paper we will recalcualte these differentials using weights for each block that depend on the number of passengers flying in each mileage block.

on connecting flights. Yet Northwest's own data shows that this hypothesis is not true. On September 20, 1999, 86 percent of discount fares were available 30 days in advance on Northwest's top 30 hub-originating routes from Minneapolis, almost the same as the 88 percent of the same fares available the same interval in advance on routes connecting through Minneapolis.

Why are more unrestricted fares sold on hub-originating flights? There are two obvious answers. The first is that business firms generating a heavy amount of unrestricted business travel, e.g., top corporate officers, lawyers, investment bankers, and management consultants, tend to be disproportionately located in hub cities.

The second reason is that a fraction of connections are made to obtain a cheaper fare on a route, e.g., Boston - San Francisco, where some carrier other than Northwest offers nonstop service. For instance, only 82.1 percent of O&D traffic between Boston and San Francisco travels on the two carriers offering nonstop service, leaving 17.9 percent to be split across connections on Northwest and other airlines. The fraction of unrestricted-fare travel on such connections is obviously much lower than on hub-originating nonstop flights, since business travelers would always choose the nonstop service on other carriers than to save a few dollars by making a connection. Time-sensitive business travel gravitates to the nonstops, whatever the airline, leaving the leisure and discount-sensitive traffic to fly on the connections.

Conclusion

This study reaches the surprising conclusion that the hub premium is a myth, at least for Northwest airlines passengers flown during the three years 1996-98. Far from charging much higher fares to its passengers its passengers who originated or terminated their travel at its three hubs in 1996-98, instead Northwest charged them roughly 4 percent less! This finding is somewhat startling, because we have made no adjustment whatsoever for the inferior quality of connecting service as compared to nonstop service. Previous studies have attributed a quality differential of 10 to 20 percent for the superior quality of nonstop travel, and we arrive at our finding of a hub discount without making any adjustment at all for the quality differential.[13]

Those passengers originating or terminating their travel in a Northwest hub receive a travel bargain compared to other passengers on Northwest airlines. Hub-originating passengers receive a higher quality product, since they have the option of flying directly to many destinations without stopping or connecting, yet our study shows that they do not pay a higher fare for this privilege. In

13. Morrison-Winston (p. 23, footnote 17) estimate a 1993 value of $37 for an on-line connection compared to an interline connection. The differential in favor of a nonstop flight compared to an on-line connection would be even greater.

fact, they pay *slightly less* on nonstop hub-originating flights than passengers pay to connect on a route of given mileage and with given advance purchase and minimum-stay restrictions.

Our results showing a hub discount differ from some previous findings not only by correcting for mileage and by treating unrestricted and restricted fares separately, but by using data solely for Northwest airlines. There is no implication in this study that Northwest charges either more or less than other airlines on trips of similar distances. However, we repeat the basic fact with which we started, and this is that Northwest has almost exactly the same average trip length as for all 10 domestic major airlines including Southwest (878 miles for Northwest vs. the average of 865) and precisely the same average ticket price ($119 for both Northwest and the average of all 10 carriers).

Data Appendix

1. Excluding feeder airline revenue.

Because of revenue accounting problems, it is necessary to subtract out the Airlink portions of the data. We were unable to do this directly by mileage breaks so we made an estimate of the aggregate effect and use this number to adjust hypothesis tests.

A significant fraction of Northwest passengers fly part of their journey on a commuter partner such as Mesaba Airlines, Northwest's feeder in Minneapolis and Detroit or Express in Memphis (AirLink is the common term Northwest Airlines uses for these separately owned feeder lines). For the purpose of creating the Northwest "Fare-break" O&D data base, AirLink passengers are assigned a prorated portion of the revenue. For example, a passenger traveling from Bemidji (Minnesota) through Minneapolis to New York is entered into the data as a MSP-NYC passenger with total revenue for the trip prorated to the MSP-NYC leg. The following is the detailed process used to obtain the data.

a. Each Fare-break O&D record contains up to four connect markets. For each Fare-break record each leg (1-4) is checked if it is a Hub market ('msp','dtw','mem'). If it is a Hub market, then it is assigned as a "connect" record. Otherwise if there are no leg markets and the fare-break origin or destination is a Hub, then it is a "nonstop" record.

b. If the Fare-break origin and destination is not a hub and there are no connect legs, this is assigned as an "other nonstop" record (ex. West Coast – Honolulu flying). These records are not used.

c. The records are then summarized (passengers, revenue, and RPMs) by "connects", "nonstops", and "other nonstops" for each hub and fare-break origin and destination. The data are run by quarter from 1998 back through 1996.

d. All data were re-stated to show nonstop RPMs as opposed to coupon RPMs.

e. In making these adjustments, we used data from Northwest Airlines true O&D (origin and destination) data for the second quarters of 1997 and 1998 (4/1 - 6/30). All domestic revenue regions were used in the data pull. NW and Airlink Connection indicators were YES (O&D travel contained at least 1 segment on NW jet and one segment on an Airlink partner).

2. Details of Data Cleaning

The data source for this section is the same as described above. In this section, we explain how we cleaned and prepared the data for analysis.

a. Summarized data by hub, by fare categories (traffic between hubs was divided 50/50 and half (of gross revenue, RPMs, and passengers) was subtracted from one hub and half from the other – correcting for double counting of these passengers).

b. Split out the "full coach discounted" category (incorrectly categorized data) Matched "full coach discounted" category by fare basis code to correct fare categories (second quarter 97 data used as proxy).

c. Calculated what percent of "full coach discounted" should be applied to each fare category by nonstop and connect categories.

d. Added back in those passengers incorrectly categorized by these percentages. Did a macro adjustment for airlink data to calculate the fare change before airlink was taken out vs. after.

e. Total airlink revenue that is included in fare-break data (as mentioned above) was subtracted from the nonstop jet revenue (where it is counted in fare-break revenue). Revenue and passengers were taken out of the fare categories in the same proportion as NW jet "connect" revenue and passengers fall (assumes the Airlink connect passengers and Jet connect passengers buy at the same proportion in fare categories – best proxy, Airlink data is not categorized).

f. Airlink revenue was taken out at the hub level, at the same percentage that total airlink passengers flow over each hub (assumes that all hubs have a similar airlink "local" vs. "connect" rate). Data for 1996 were not available for this process. Therefore, 1997 were used as a proxy. The percent of passengers that flew Airlink in 1997 was used to calculate the number of passengers that flew Airlink in 1996. The hub breakout for 1997 was also applied to the calculated 1996 system numbers.

g. Average fare for the nonstop traffic vs. connect traffic was calculated before and after the Airlink adjustment.

3. Data Used in Fare Regressions. The data used in the fare regressions were obtained from the same sources described above and in addition:

a. Summarized data by mileage break, by fare description (concentrated on mileage breaks less than or equal to 2500 miles for connect traffic and less than or equal to 2000 miles for nonstop traffic). Removed data points with low passenger counts.

b. Adjusted system level data by subtracting Airlink data (shown on different pages in file).

Table 1
1996-1998 Nonstop and Connecting Traffic Into and Out Of NWA's Three Hubs

	System				MSP				DTW				MEM			
	Nonstop		Connect		Nonstop		Connect		Nonstop		Connect		Nonstop		Connect	
	RPM Mix	Avg Fare	RPM Mix	Avg Fare	RPM Mix	Avg Fare	RPM Mix	Avg Fare	RPM Mix	Avg Fare	RPM Mix	Avg Fare	RPM Mix	Avg Fare	RPM Mix	Avg Fare
First/Business Class	2%	$459	0%	$495	2%	$492	0%	$555	2%	$440	0%	$441	2%	$421	0%	$452
Full Coach/ Connect First	9%	$388	5%	$480	11%	$432	5%	$558	7%	$355	6%	$421	9%	$340	4%	$445
Total Group 1	**11%**	**$400**	**6%**	**$481**	**13%**	**$440**	**6%**	**$558**	**9%**	**$372**	**6%**	**$423**	**11%**	**$354**	**5%**	**$445**
Adjusted Group 1	**12%**	**$381**	**6%**	**$480**	**13%**	**$437**	**6%**	**$556**	**9%**	**$371**	**6%**	**$421**	**12%**	**$353**	**5%**	**$444**
Corporate	7%	$259	4%	$284	6%	$326	3%	$323	8%	$219	4%	$265	8%	$231	4%	$261
Meeting	1%	$168	1%	$182	2%	$184	1%	$201	1%	$150	1%	$165	1%	$143	1%	$164
Total Group 2	**9%**	**$246**	**4%**	**$264**	**8%**	**$298**	**4%**	**$294**	**9%**	**$211**	**5%**	**$248**	**9%**	**$221**	**4%**	**$245**
Adjusted Group 2	**11%**	**$225**	**5%**	**$252**	**8%**	**$275**	**4%**	**$283**	**9%**	**$192**	**5%**	**$236**	**9%**	**$202**	**5%**	**$234**
Disc. Unrestricted 0-6	8%	$116	7%	$173	7%	$131	6%	$204	9%	$109	8%	$161	6%	$110	9%	$150
Disc. Unrestricted 7-13	2%	$105	1%	$163	1%	$100	1%	$189	2%	$118	2%	$164	2%	$73	2%	$128
Disc. Unrestricted 14+	4%	$78	5%	$107	2%	$67	4%	$120	5%	$91	4%	$102	5%	$59	7%	$95
Promotions Published	14%	$119	16%	$148	17%	$128	18%	$162	10%	$112	15%	$130	11%	$107	10%	$133
Substructure Restricted	21%	$107	19%	$130	19%	$122	18%	$143	25%	$100	20%	$123	23%	$97	23%	$115
Excursions 0-6	0%	$123	0%	$183	0%	$129	0%	$189	0%	$123	0%	$182	0%	$120	0%	$172
Excursions 7-13	1%	$232	1%	$304	2%	$256	1%	$341	1%	$213	1%	$272	1%	$207	1%	$273
Excursions 14+	2%	$155	2%	$207	3%	$171	3%	$230	2%	$143	2%	$179	2%	$143	1%	$190
Other	24%	$112	32%	$140	24%	$119	32%	$151	23%	$111	32%	$130	27%	$101	31%	$130
Total Group 3	**80%**	**$108**	**90%**	**$135**	**79%**	**$117**	**90%**	**$149**	**82%**	**$103**	**89%**	**$125**	**80%**	**$97**	**91%**	**$121**
Adjusted Group 3	**78%**	**$108**	**89%**	**$135**	**78%**	**$117**	**90%**	**$149**	**82%**	**$103**	**88%**	**$125**	**79%**	**$97**	**90%**	**$121**
Total	100%	$152	100%	$161	100%	$172	100%	$179	100%	$136	100%	$149	100%	$137	100%	$142

This table contains the raw data that will be used in this report

Table 2
Percentage of Traffic Flown in Higher-Fare Categories Originating at Hubs 1996-1998

	System		MSP		DTW		MEM	
	Nonstop	Connect	Nonstop	Connect	Nonstop	Connect	Nonstop	Connect
Total Group 1	11%	6%	13%	6%	9%	6%	11%	5%
Total Group 2	9%	4%	8%	4%	9%	5%	9%	4%
Total Group 3	80%	90%	79%	90%	82%	89%	80%	91%
Total	100%	100%	100%	100%	100%	100%	100%	100%

For the system and each hub, there is a higher percentage of traffic flown in the higher-fare categories (Groups 1 and 2) for hub originating traffic than for traffic connecting through the hubs.

Table 3
Ratio of Nonstop to Connecting Fares All Hubs 1996-1998

	System		MSP		DTW		MEM	
	RPM Mix	Nonstop Connecting Ratio	RPM Mix	Nonstop Connecting Ratio	RPM Mix	NonStop Connecting Ratio	RPM Mix	Nonstop Connecting Ratio
First/Business Class	2%	93%	2%	89%	2%	100%	2%	93%
Full Coach/ Connect First	9%	81%	11%	77%	7%	84%	9%	76%
Total Group 1	**11%**	83%	**13%**	79%	**9%**	88%	**11%**	80%
Adjusted Group 1	**12%**	83%	**13%**	79%	**9%**	88%	**12%**	79%
Corporate	7%	91%	6%	101%	8%	83%	8%	88%
Meeting	1%	92%	2%	91%	1%	91%	1%	87%
Total Group 2	**9%**	93%	**8%**	101%	**9%**	85%	**9%**	90%
Adjusted Group 2	**9%**	89%	**8%**	97%	**9%**	81%	**9%**	86%
Disc. Unrestricted 0-6	8%	67%	7%	64%	9%	68%	6%	73%
Disc. Unrestricted 7-13	2%	64%	1%	53%	2%	72%	2%	57%
Disc. Unrestricted 14+	4%	73%	2%	56%	5%	89%	5%	62%
Promotions Published	14%	81%	17%	79%	10%	86%	11%	80%
Substructure Restricted	21%	83%	19%	85%	25%	81%	23%	84%
Excursions 0-6	0%	67%	0%	68%	0%	67%	0%	70%
Excursions 7-13	1%	76%	2%	75%	1%	78%	1%	76%
Excursions 14+	2%	75%	3%	74%	2%	80%	2%	75%
Other	24%	80%	24%	79%	23%	85%	27%	77%
Total Group 3	**80%**	80%	**79%**	79%	**82%**	82%	**80%**	80%
Adjusted Group 3	**76%**	80%	**78%**	79%	**82%**	82%	**79%**	80%
Total	**100%**	94%	100%	97%	100%		100%	96%

The table shows the ratio of nonstop to connecting fares. The ratio is uniformly below 100 percent with one exception indicating that within each fare category the nonstop hub-originating fare is lower, not higher, than the equivalent fare connecting through hubs.

Table 4
Mileage on Connecting versus Nonstop flights All Hubs 1996-1998

	System				MSP				DTW				MEM			
	Nonstop		Connect		Nonstop		Connect		NonStop		Connect		Nonstop		Connect	
	Mileage	Avg Fare	Mileage	Avg Fare	Mileage	Avg Fare	Mileage	Avg Fare	Mileage	Avg Fare	Mileage	Avg Fare	Mileage	Avg Fare	Mileage	Avg Fare
First/Business Class	1,055	459	1,526	495	1,055	492	1,744	555	848	440	1,330	441	777	421	1,338	452
Full Coach/ Connect First	828	388	1,117	480	828	432	1,418	558	553	355	903	421	584	340	943	445
Total Group 1	855	400	1,140	481	855	440	1,439	558	591	372	923	423	605	354	968	445
Adjusted Group 1		398		480		437		556		371		421		353		444
Corporate	884	259	1,107	284	884	326	1,473	323	659	219	912	265	722	231	1,026	261
Meeting	1,072	168	1,301	182	1,072	184	1,454	201	943	150	1,152	165	808	143	1,131	164
Total Group 2	917	246	1,141	264	917	298	1,468	294	681	211	943	248	730	221	1,041	245
Adjusted Group 2		225		252		275		283		192		236		202		234
	875		1,140		875		1,448		627		931		646		998	
Disc. Unrestricted 0-6	573	116	1,168	173	573	131	1,461	204	570	109	1,026	161	613	110	1,004	150
Disc. Unrestricted 7-13	637	105	1,124	163	637	100	1,404	189	721	118	914	164	601	73	1,045	128
Disc. Unrestricted 14+	566	78	1,238	107	566	67	1,376	120	755	91	1,203	102	664	59	1,036	95
Promotions Published	1,077	119	1,384	148	1,077	128	1,552	162	901	112	1,202	130	821	107	1,210	133
Substructure Restricted	1,224	107	1,441	130	1,224	122	1,708	143	1,021	100	1,281	123	922	97	1,183	115
Excursions 0-6	990	123	1,606	183	990	129	1,663	189	816	123	1,547	182	715	120	1,485	172
Excursions 7-13	919	232	1,248	304	919	256	1,473	341	703	213	1,039	272	717	207	1,100	273
Excursions 14+	951	155	1,341	207	951	171	1,553	230	699	143	1,078	179	669	143	1,051	190
Earned Award	1,189	2	1,587	2	1,189	1	1,784	2	1,182	2	1,457	2	931	2	1,367	2
Other	1,180	112	1,585	140	1,180	119	1,738	151	1,116	111	1,472	130	890	101	1,387	130
Total Group 3		108		135		117		149		103		125		97		121
Adjusted Group 3	993	108	1,393	135	993	117	1,607	149	831	103	1,233	125	766	97	1,185	121
Total		152		161		172		179		136		149		137		142

Elapsed mileage is longer, on average, for connecting flights than for nonstop flights.

Table 5
Calculation of Hub Premium

	Group 1	Group 2	Group 3	Alternative Averages
1. Weight Mileage Blocks Equally, Weight by RPMs	2.9	2.3	-6.0	-4.7
2. Weight Mileage Blocks Equally, Weight by Pax	2.9	2.3	-6.0	-4.3
3. Average Revenue, Weight by RPMs	1.9	3.3	-6.3	-5.0
4. Average Revenue, Weight by Passengers	1.9	3.3	-6.3	-4.6
5. Mileage-adjusted average fare				8.3
6. Mileage-weighted average fare with equal group weights for nonstop and connect				-4.3

Alternative weighings, all of which arrive at the same conclusion: There is no hub premium at all, and instead there is a hub discount in the range of -4.3 to -5.0 percent.