

# **Low-Cost Carriers and Low Fares: Competition and Concentration in the U.S. Airline Industry**

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Charles Najda

## **Abstract**

This analysis will examine the current structure of the domestic airline market to determine the amount of market power incumbent carriers wield, the market dynamics that exist in short haul and long haul routes, and the impact of a new breed of air carrier, the low-cost carrier, on the distribution of airfares. The analysis seeks to determine if a low-cost carrier's presence on a route significantly impacts airfares. This paper argues that previous analyses may overestimate the effect of route concentration, hubs, and other route specific characteristics on the distribution of market prices. The emerging significance of the low-cost carrier may indicate a shift in the structure of the airline market away from hub-and-spoke networks and towards point-to-point networks. The significance of low-cost carriers suggests that government policies that enforce antitrust laws at hub airports may be ineffective; moreover, encouraging low-cost entry, through equal access to infrastructure, compacts the fare distribution and lowers the median fare.

## **1. Introduction**

This paper analyzes the current state of the airline market to determine the impact of a new breed of air carrier, the low-cost carrier, on airfares, the market dynamics that exist in short haul and long haul routes, and by what degree previous analyses overstate the importance of hubs and concentration. Although, financial turmoil surrounds the airline industry today, the evolution of the domestic airline market, in the United States, continues. Since deregulation in 1978, the cost of air travel has fallen and the size of the airline industry has grown rapidly. The early predictions of economists that airline deregulation would improve consumer welfare have been proven to be correct (Borenstein 1992). Over ten years after deregulation, Borenstein (1989) finds that high levels of route and hub concentration are correlated with higher airfares. Hubs impact the entire distribution of fares for all flights originating or terminating at those hub airports. Moreover, potential competition has little if any disciplining affect on market prices.

The conclusions that Borenstein (1989) derives from an analysis of the airline market are still valid today; moreover, without controlling for the presence of low-cost carriers, hubs and high levels of concentration skew the price distribution and shift it rightwards. Even after controlling for route specific characteristics such as distance, load factor, and aircraft equipment route and airport concentration are estimated to raise prices at each point of a route's price distribution. Today's airline market has evolved markedly since the late 1980s. While low-cost carriers only carry 15% of the domestic traffic in the United States, their impact on prices is significant and broadly distributed over the marketplace (Parker Oct 17, 2002). This paper argues that most of the hub effect is due to the lack of a low-cost carrier serving that hub and not associated with the hub itself. More generally, the measurable change in price distributions associated with high levels of route and airport concentration is

overstated. Much of the concentration effect is directly attributable to the presence of a low-cost airline or in this case the lack thereof.

The disciplining force of the low-cost carrier is apparent in the regional airline market, where Richards (1996) finds that the potential presence of Southwest measurably lowers airfares. Yet, Richards postulates that Southwest (a low-cost carrier) does not have the same impact in the long haul market as it does in the regional market. This analysis argues that low-cost carriers, such as Southwest and JetBlue, continue to discipline prices in the regional market but also discipline prices in the long haul market. A significant change in the distribution of prices is no longer a direct consequence of levels of route and airport concentration when low-cost carriers are represented in the estimated equations.

The impact of a low-cost carrier is independent of market distinctions and subdivisions. On each route, regardless of its characteristics, a low-cost presence alters the distribution of airfares to produce a distribution with a tighter range and lower median fare. Borenstein shows that high levels of route and airport concentration, characteristic of airline hubs, raise fares at the high-end of the market's price distribution; however, low-end fares are not untouched, these factors raise low-end fares as well. Thus measures of route and airport concentration affect the range and height of each and every route price distribution. Although, concentration levels may alter each fare in a distribution, Borenstein argues that these measures impact the highest percentile fares to the greatest extent. This paper determines that the largest shift in the expected price paid is consistently at the upper tail of the price distribution. To this day, route and hub concentration continue to primarily alter the shape of the composition of airfares to a greater degree at higher price percentiles. This paper's baseline estimates would imply that the concentration effect is as much of a factor today as in the Borenstein (1989) analysis; however, important interactions, not limited to concentration measures, call into question the validity of this paper's baseline equations. The level of

concentration, along with other often used route characteristics, no longer provides as accurate an account of the airline market as possible.

A low-cost presence lowers prices at the low end, median, and high-end of ticket prices in all market segments. In other words, this new breed of air carrier disciplines market prices at any price point within a given market. The broadening impact of the low-cost carrier across price points suggests that the airline market is evolving; moreover, the level of many of the effects economists have attributed to concentration levels, hubs, and slot constraints may in fact be overstated. Instead of measuring the relationship between concentration levels, hubs, slot constraints and prices this paper argues that previous econometric analyses may have actually been measuring the impact on a route or airport of not having a low-cost carrier. An understanding of the significance of the low-cost carrier requires insight into what constitutes a low-cost carrier. The ability of the low-cost carrier to compete with established hub-and-spoke carriers on price represents an evolution of the airline market in the United States.

This thesis argues that a change in the conventional method of analysis is necessary to build an accurate dynamic model for estimating prices. That critical change involves altering standard models of analysis in order to measure the impact of low-cost carriers. Measures of concentration may have never been as key to understanding the dynamics of the airline market as previously suggested. Not controlling for low-cost carriers, today's airline market resembles the market of the late 1980s even though a variety of structural changes have taken place since then. The measurable impact of the low-cost carriers has two implications. First, the presence of a low-cost carrier causes the distribution of prices to flatten and shift left. The median fare is lower and price volatility is lower. Second, the lack of a low-cost presence raises prices. Borenstein is not only measuring the impact of concentration with controls for

route and airport dominance, but also is measuring the lack of a low-cost presence through those variables.

Low-cost carriers cause price distributions to compact and shift lower across all market segments. Hence, a large fraction of the concentration effect is directly due to the lack of a low-cost presence. An examination of previous literature written on the airline markets and the principle market participants provides a solid superstructure within which a model can be built to determine the range of the low-cost carriers' impact on the marketplace. The low-cost carriers' growing market share brings to light the consequence of competitive entry in the airline industry. Moreover, a low-cost presence is correlated with a flatter price distribution, a higher degree of competitiveness, and a decline in the relevance of concentration, frequency, hubs, and capacity constraints in predicting market prices. This result suggests any future analysis of the competitive structure of the airline industry should take into account the low-cost effect.

## **2. Low-Cost Carrier: A Definition**

This paper defines the low-cost carrier to be an airline that operates a point-to-point network, pays employees below the industry average wage, and offers no frills service. The two most prominent low-cost carriers, JetBlue and Southwest, both have labor costs 30% to 40% lower than the mainline carriers. A traditional major carrier often has a number of tools at its disposal, which it can use to deter entry or lessen the competitiveness of recent entrants. These tools include predatory pricing, loyalty programs, and congestion at the nation's most popular airports. Yet, these tools are not effective against low-cost carriers with point-to-point networks. A low-cost airline can engage in Bertrand competition, with a high-cost competitor,

without pricing at its own marginal cost. The low-cost carrier can successfully neutralize the dominance of its competitors, by competing on price.

The lower cost structure can be quantified by aggregating the cost savings of point-to-point networks, wage savings, and savings from not providing numerous add-on services. While labor costs are the largest single cost item for airlines, there are many other costs. The pie chart in Figure 1 illustrates the composition of costs for the aggregate airline industry in 2000. The cost differential between the low-cost and major carriers is not only attributable to the wage differential. Although, the primary cost for any carrier is labor related. Controlling labor costs can improve the bottom line. The operating cost distribution below suggests that lowering labor costs by 10% can lower the average airline's total cost by 3.68%.

The lower cost structure of a point-to-point network is a consequence of a number of factors. They include: Airport congestion, which causes costly delays at hubs and is not as prevalent at airports used by point-to-point carriers. For every major metropolitan airport there are often two to three secondary airports. Low-cost carriers can achieve fast turnarounds and pay less for leasing airport facilities at secondary airports like TF Green airport outside Providence, Rhode Island.

In comparison, hubs require a large number of gates and personnel per flight, due to the banks of arriving and departing flights. The banks of flights result in the majority of flights arriving and departing within 20-30 minutes of each other. These peak periods result in a high demand for facilities and personnel for. For example, at its Dallas Fort Worth hub American operates banks of flights to make connections convenient. While at neighboring Dallas Love Field Southwest spaces its flights out due to the lower emphasis it places on connecting traffic. The close proximity of flights at peak times provides customers a high level of convenience but creates operating inefficiencies. Employees stand around between peaks, while planes wait in line to take off. The higher number of personal required per flight

to effectively operate a traditional hub may be an important factor in the different cost structures of traditional and low-cost carriers. “Spreading out peak travel times at hub airports by several more hours each day, a concept known as rolling hubs, may be one way to make operations more efficient” (Business Week Oct 23, 2002). Major carrier American Airlines is experimenting with a rolling hub in Chicago in an attempt to achieve lower operating costs.

The two most prominent low-cost carriers, JetBlue and Southwest, both have lower labor costs than the large incumbent carriers. Analysts estimate that Low-cost carriers such as Southwest and JetBlue have labor costs 30% to 40% lower than the mainline carriers. Although, Delta Air Lines and Alaska Airlines have the lowest costs of the majors, each of them has unit costs 30% higher than Southwest’s (Wall Street Journal Oct 9, 2002). Table 1 provides a break down of costs and revenue on an ASM (available seat mile) basis for major and low-cost carriers. Low-cost carriers have substantially lower unit costs; however, they do not have substantially lower unit operating revenue.

**Table 1 Operating Cost and Revenue for Carriers of Interest**

Domestic Carrier	Operating cost per available seat mile (cents) / 2001	Operating revenue per available seat mile (cents) / 2001
American Airlines	11.41	9.22
Continental Airlines	9.58	9.78
Delta Airlines	10.14	9.39
JetBlue Airways	6.81	8.26
Southwest Airlines	7.54	8.51
United Airlines	12.00	9.80

Note: All figures are for the twelve month period ended December 31, 2001, except for the JetBlue figures which are for the first quarter of 2002.

Source: 10-K, for fiscal year ended December, 31 2001 for each respective carrier, except for the JetBlue figures which are sourced from the firm’s 10-Q, for the quarterly period ended March, 31 2002.

Perhaps the most obvious attribute of the low-cost carrier is the no frills service that these carriers offer. Instead of providing passengers with a menu of choices priced within a range, the low-cost carriers offer a single type of product, coach service. Low-cost carriers do

not provide meals on flights, which results in a savings of 5 to 10 dollars per coach passenger or up to 3.2% of the average carrier's operating cost (see Figure 1). These airlines lack elaborate loyalty programs, which necessitate extra employees, to provide more personalized service, and expensive facilities, like airport clubs. Low-cost airlines do not provide costly services, which are only profit enhancing for a hub-and-spoke carrier able to extract a high level of rents from customers with a high willingness to pay, business travelers. The main advantage of the low-cost carrier is that it can compete on price. Indeed, this characteristic of the low-cost carrier is perceptible; moreover, this paper argues that the impact of this unique structure on the airline market is just as evident.

### **3. Importance of Concentration & Low-Cost Carriers**

The academic work of economists was a significant force in the movement towards the deregulation of the domestic airline industry in the early 1970s (Borenstein 1992). Post deregulation, most analysis of the airline markets focuses on the lack of competition among the airlines; however, the early predictions of economists that airline deregulation would improve consumer welfare have in fact been proven to be correct (Borenstein 1992). Moreover, Borenstein (1992) argues that the most important lessons that have been learned from the deregulation of the airline industry are not with regard how to deregulate, but are a better understanding of the strategies and results of competition in a complex and innovative service industry.

As the airline industry matures, in a parallel fashion the analysis and understanding of the airline industry matures as well. During the 1980s, journal articles, which argued that the airline industry would exhibit perfect contestability, accompanied the recent deregulation of the airline industry (Beesley 1986). The analysis of Beesley (1986) in the United States and

Joy (1986) in Australia suggested that airlines could not sustain ticket prices far in excess of marginal cost, because new entry could easily take place due to the low barriers to entry of the airline industry.

However, “It has now been well established that airline pricing does not closely reflect the perfect contestability ideal” (Borenstein 1989, P. 344). The airline market is not perfectly contestable, because barriers to entry make it difficult for new entrants to break into the airline market. Price discrimination is the norm not the exception, on routes with high barriers to entry. As a result, much of the recent analysis of the airline industry has focused on trying to explain what factors prevent entry, which would increase competition and result in lower fares.

Borenstein (1989) chooses to focus on the importance of route and airport dominance in determining the degree of market power exercised by an airline. The results of the paper indicate that an airline’s share of passengers on a route and at the endpoint airports significantly influences its ability to mark up price above cost. The two primary factors that determine the difficulty of entry into an airport are slot and gate constraints (Borenstein 1989). Capacity restrictions, or more formally control of a dominant share of slots or gates, “...can allow an airline to inhibit profitable entry” (Borenstein 1989, P. 348). Capacity restrictions can benefit incumbent carriers and “have a positive effect on yields” along with computer reservation systems and loyalty programs (Richards 1996, P. 44). In contrast, raising fares at an airport with no capacity constraints attracts entrants, which in turn forces airfares back down.

Besides taking advantage of capacity restrictions, the major airlines use a number of programs in an attempt to raise prices. Marketing devices give an advantage to a dominant carrier and amplify the market power of that incumbent airline (Borenstein 1989). In

particular, frequent flier programs encourage airline loyalty, especially among customers who primarily fly from an airport that is a major hub of an airline (Levine 1987).

Both airline ownership of computer reservation systems (CRS) and scarce airport facilities increase an airline's localized market power (Evans 1993). American and United were early entrants into the computer reservation service industry. The American and United reservation systems (Sabre and Apollo respectively) create a bias in travel agent booking, called the "halo effect" (Borenstein 1992). The "halo effect" is when a travel agent using an Apollo system books on average a disproportionate share of his or her tickets on United Airlines (Borenstein 1992). An airline's CRS system enhances its market power; however, the growth in internet bookings calls into question the influence of the "halo effect" on airfares.

The results of the Borenstein (1989) analysis support the observation that an airline charges higher prices when it has a dominant position at an airport. Moreover, at hub airports the dominant carrier charges higher prices than it does in the remainder of its system. Cost factors do not explain the discrepancy in prices (Borenstein 1989). The primary conclusion is that an individual airline's share of traffic on the route and at the endpoint seems to be a principle determinant of a carrier's ability to raise the price of its product (Borenstein 1989). Evans (1993) refines Borenstein's (1989) earlier article by distinguishing between the impact of route dominance versus airport dominance on an airline's level of market power. Evans tests whether the observed dominance of most intercity-pair markets and airports in the United States airline industry by single carriers confers pricing power on the dominant firm. Evans concludes that airport dominance by a carrier does confer significant pricing power, whereas dominance at the route level seems to confer no such pricing power.

Whinston and Collins (1992) conduct an event study analysis of People Express, in order to measure the competitive structure of the airline markets. Instead of examining measures of concentration, Whinston and Collins (1992) use the reactions of incumbent

airlines' stock prices to announcements of entry by People Express to determine the competitive structure of the airline markets. The stock reactions reveal significant route-specific profits. A decline in an incumbent airline's equity value suggests that equity market participants recognize that entry will reduce an incumbent's profits. While the analysis of Whinston and Collins is unique, the use of an airline's equity price as a proxy for competitiveness may not be the most direct way to measure competitiveness.

While many factors can influence the movement of an airline's stock price, Richards (1996) chooses to examine the airline markets in an innovative manner, focusing on competition not concentration. Richards estimates a series of fare equations to ascertain the effects of actual and potential competition by Southwest on markets for air travel. The results of the analysis suggest that pricing strategies of competitors differ depending on Southwest's presence on a route (Richards 1996). The presence of a low fare carrier may be a more important determinant of the ticket pricing on a particular route than the extent of route and hub concentration on that route. The analysis and conclusion of Richards (1996) parallels the analysis and forthcoming conclusion of this paper.

The major carriers successfully use dominance enhancing strategies to raise concentration levels that in turn raise the market price for air travel. Moreover, low-cost entry disciplines prices on short haul routes. The rapid expansion of the low-cost presence in the airline markets over the last half decade and the continued dominance of the major carriers together raise the following question. Are concentration levels or a low-cost presence the more important predictor of market fares? The juxtaposition of these opposing factors in this paper provides an answer to the question of which factor is critical to understanding the dynamics of pricing in the airline markets.

#### 4. The Data

In order to determine whether or not low-cost carriers significantly impact the pricing of tickets in airline markets this paper will conduct an econometric analysis using the Department of Transportation's Databank 1B database. The database is a 10% random sample of all domestic tickets sold in the United States. This analysis employs the second quarter 2002 dataset. This dataset includes over 4,600,000 individual ticket observations. The dataset includes 31 carriers, 415 airports, and 9150 different routes. Hence, the dataset for the regressions contains a total of 16,746 route carrier pairs.

The Origin and Destination survey includes data on the length and number of passengers of routes. The Herfindahl-Hirschman Indices are derived from this dataset. Low-cost market share measures are constructed from the dataset by segregating the market share measures based on whether or not the carrier is deemed to be a low-cost carrier. For the purposes of this analysis, there are 10 low-cost carriers. A comprehensive list of all the represented airlines is included in Table 5. To compute cost per available seat mile (CASM) figures for all 31 airlines, subsections of Department of Transportation's Schedule T-1 and Schedule P-12 datasets are utilized to construct the CASM figures. The schedule T-1 dataset summarizes the T-100 by providing monthly compilations, by carrier of such items as available seat miles, available ton miles, revenue passenger miles, revenue miles flown, and revenue departures performed. The Schedule P-12 provides quarterly profit and loss statements for carriers with annual operating revenues of \$20 million or more. Since Airtran Airways, Northwest Airlines, Horizon Air, and TCI Skyking were not in the P-12, these carriers are excluded from this paper's dataset. However, a regression run with these carriers and proxy cost per available seat mile (CASM) figures reveals that excluding these carriers does not alter the sign or significance of this paper's results. The CASM figures are calculated for the year 2002.

Frequency, load factor, and equipment variables are constructed using data aggregated from the Department of Transportation T-100 Domestic Segment dataset for the months of April, May, and June 2002. Thus the union of the three datasets corresponds to the second quarter of 2002. The T-100 Domestic Segment dataset contains information by aircraft type and service class for departures performed, available capacity and seats, passengers enplaned, scheduled departures, and aircraft hours ramp-to-ramp and airborne. The Department of Transportation Databank 1B, Schedule T-1, Schedule P-12, and T-100 Domestic Segment databases are all publicly available through the recently constructed Bureau of Transportation Statistics (BTS) TransStats website.<sup>1</sup>

## **5. Methodology**

Having outlined the progression of academic thought on the factors that influence ticket prices and having argued that low-cost carriers have a fundamentally different cost structure than their competitors, an analysis examining the impact of the low-cost carrier is warranted. The 3 econometric models developed in this section of the thesis estimate the marginal benefit of low-cost entry by quantifying the impact of several measures of concentration on the market price for air travel. The three models include a baseline model that closely resembles Borenstein's (1989) equation, a 6-segment distance model that includes the baseline variables plus dummy variables measuring the change in price over discrete 500 mile segments, and a short/long haul segment model that includes the baseline variables plus 2 indicators that classify a route as either regional market or long haul.

The price equation is estimated as a function of costs, product quality, market demand characteristics, and other factors such as route concentration, route characteristics, hub concentration, and low-cost carrier route and hub concentration. Roundtrip tickets are treated

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<sup>1</sup> The BTS TransStats website can be found at the following web address: <http://www.transtats.bts.gov>.

as two one way tickets and roundtrip fares are adjusted accordingly. The equations that follow will be used in conjunction with the constructed dataset to show the low-cost carriers' impact on prices and other route characteristics.

Following Borenstein (1989), each of the three models is regressed on the sample 20<sup>th</sup>, 50<sup>th</sup>, and 80<sup>th</sup> percentile fare for each route-carrier pair. As Borenstein notes, the segmentation of each equation into three regressions provides insight into the impact of concentration levels and low-cost participation on different strata of the ticket price spectrum. This paper includes three basic models, regressed with and without a set of low-cost carriers. These 18 equations converge to three hybrid models that seek to determine the significance of two primary variables, which can affect the supply curve for air travel, the level of competition and concentration in the airline markets.

The baseline equation, based on a Borenstein (1989) pricing equation, is a logical starting point from which to begin an analysis exploring the impact of low-cost carriers. The baseline equation, regressed on second quarter 2002 Department of Transportation data, brings Borenstein's (1989) analysis to the present day and brings to light any changes that have occurred in the structure of the airline market over the last 15 years.

The baseline equation is also estimated with a set of variables that measure the significance of the low-cost carriers. These variables include low-cost market share and a dummy variable that indicates whether or not an endpoint airport is a hub of a low-cost airline. The low-cost variables are analogous to the POTCOMP (potential competition) variable that Borenstein (1989) includes in his second set of regressions. However, the POTCOMP measure does not distinguished between mainline and low-cost carriers. Thus the measure only quantifies the effect of potential competition and not actual competition (from low-cost carriers). It is important to note that, "(the) inclusion of the potential competition variable does not change the results (of the regression) substantially, though it may have a

significant effect itself at least on lower fares” (Borenstein 1989, P. 359). Borenstein’s results suggest that low-cost carriers may only be an important factor acting on prices at the 20<sup>th</sup> percentile. The juxtaposition of these two sets of regressions should reveal the impact of the low-cost carrier on pricing in the airline market and whether Borenstein’s (1989) initial conclusion still holds.

**Baseline Equation**

$$\ln P_{ij} = \alpha_i + \beta_1 \ln \text{MKTDIST}_j + \gamma_1 \ln \text{LOADFAC}_{ij} + \gamma_2 \text{COUPON}_{ij} + \gamma_3 \ln \text{EQUIP}_{ij} + \gamma_4 \ln \text{FREQ}_{ij} + \delta_1 \ln \text{ORGSHARE}_{ij} + \delta_2 \ln \text{ORGHERF}_j + \delta_3 \text{RUTSHARE}_{ij} + \delta_4 \text{RUTHERF}_j + \delta_5 \ln \text{COMPCOST}_{ij} + \delta_6 \text{TOURIST}_j + \delta_7 \text{HUB}_j + \delta_8 \text{LWC SHUB}_j + \delta_9 \text{SLOT}_j$$

**Baseline Equation with Low-Cost Variables**

$$\ln P_{ij} = \alpha_i + \beta_1 \ln \text{MKTDIST}_j + \gamma_1 \ln \text{LOADFAC}_{ij} + \gamma_2 \text{COUPON}_{ij} + \gamma_3 \ln \text{EQUIP}_{ij} + \gamma_4 \ln \text{FREQ}_{ij} + \delta_1 \ln \text{ORGSHARE}_{ij} + \delta_2 \ln \text{ORGHERF}_j + \delta_3 \text{RUTSHARE}_{ij} + \delta_4 \text{RUTHERF}_j + \delta_5 \ln \text{ORGLWC SHARE}_j + \delta_6 \text{LWCSTSHARE}_j + \delta_7 \text{LWCSTHERF}_j + \delta_8 \ln \text{COMPCOST}_{ij} + \delta_9 \text{TOURIST}_j + \delta_{10} \text{HUB}_j + \delta_{11} \text{LWC SHUB}_j + \delta_{12} \text{SLOT}_j$$

Market distance can impact the price of a ticket due to the change in cost structure over different route lengths. Takeoffs and landings are highly inefficient and require up to 50% of a flight’s fuel. As a result, longer routes, on which the fixed cost of the takeoff and landing is spread out, are less expensive to operate per mile. However, different market distances are not just associated with direct costs to the airlines. Using a continuous variable such as MKTDIS establishes a linear relationship between route distance and price. This linear relationship may indicate a general trend as route length increases; however, a significant coefficient on MKTDIS does not answer the question of whether or not distance is linearly related to price. In order to determine if the relationship between distance and price varies over length it is necessary to test discrete segments of length.

This paper categorizes different route lengths as separate markets in order to test the hypothesis that each of these market segments has a unique competitive structure. High prices may categorize certain route lengths due to the variability of concentration levels over

several types of routes. To quantify the impact of route distance on ticket prices this analysis employs a second set of equations that employ 6 dummy variables representing 6 consecutive 500 mile increments in route length. The baseline and excluded variable is MKTDIS\_1, the 1-500 mile market segment. With these 6 dummy variables it is possible to construct a segment by segment relationship between price and distance. As with the baseline equation, the six segment equation is constructed in its base form and with 4 low-cost variables to measure the impact of the low-cost carriers on pricing over the 6 distance segments. In particular, these equations may identify the relative importance of low-cost carriers over distance. Do low-cost carriers only impact pricing on short haul routes as Richards (1996) postulates?

### **Six Segment Distance Equation**

$$\ln P_{ij} = \alpha_i + \beta_1 \ln \text{MKTDIST}_j + \gamma_1 \ln \text{LOADFAC}_{ij} + \gamma_2 \text{COUPON}_{ij} + \gamma_3 \ln \text{EQUIP}_{ij} + \gamma_4 \ln \text{FREQ}_{ij} + \delta_1 \ln \text{ORGSHARE}_{ij} + \delta_2 \ln \text{ORGHERF}_j + \delta_3 \text{RUTSHARE}_{ij} + \delta_4 \text{RUTHERF}_j + \delta_5 \ln \text{COMPCOST}_{ij} + \delta_6 \text{TOURIST}_j + \delta_7 \text{HUB}_j + \delta_8 \text{SLOT}_j + \delta_9 \text{MKTDIS\_1}_j + \delta_{10} \text{MKTDIS\_2}_j + \delta_{11} \text{MKTDIS\_3}_j + \delta_{12} \text{MKTDIS\_4}_j + \delta_{13} \text{MKTDIS\_5}_j + \delta_{14} \text{MKTDIS\_6}_j$$

### **Six Segment Distance Equation with Low-Cost Variables**

$$\ln P_{ij} = \alpha_i + \beta_1 \ln \text{MKTDIST}_j + \gamma_1 \ln \text{LOADFAC}_{ij} + \gamma_2 \text{COUPON}_{ij} + \gamma_3 \ln \text{EQUIP}_{ij} + \gamma_4 \ln \text{FREQ}_{ij} + \delta_1 \ln \text{ORGSHARE}_{ij} + \delta_2 \ln \text{ORGHERF}_j + \delta_3 \text{RUTSHARE}_{ij} + \delta_4 \text{RUTHERF}_j + \delta_5 \ln \text{ORGLWC SHARE}_j + \delta_6 \text{LWCSTSHARE}_j + \delta_7 \text{LWCSTHERF}_j + \delta_8 \ln \text{COMPCOST}_{ij} + \delta_9 \text{TOURIST}_j + \delta_{10} \text{HUB}_j + \delta_{11} \text{LWC SHUB}_j + \delta_{12} \text{SLOT}_j + \delta_{13} \text{MKTDIS\_1}_j + \delta_{14} \text{MKTDIS\_2}_j + \delta_{15} \text{MKTDIS\_3}_j + \delta_{16} \text{MKTDIS\_4}_j + \delta_{17} \text{MKTDIS\_5}_j + \delta_{18} \text{MKTDIS\_6}_j$$

The impact of low-cost carriers may vary over market distance; moreover, there are two primary market segments in the United States, short haul (regional) routes and long haul routes. This paper categorizes regional routes as being 0-1500 miles in length. Long haul routes are defined to be 1501-3000 miles in length. Traditionally low-cost carriers, such as Southwest, serve regional routes and avoid competing on higher profile long haul routes; however, recently, Southwest is adding longer routes. Moreover, JetBlue with hubs at John F. Kennedy Airport (JFK) and Long Beach Airport (LGB) is directly targeting long haul transcontinental routes, which lacked a low-cost presence. Although, the low-cost presence on

long haul routes (1500 miles in length or more) is still small this paper seeks to determine if that presence significantly disciplines the pricing behavior of the incumbent nationwide carriers.

The two additional indicator variables (MKTDISREG and MKTDISLNG) provide a direct means with which to measure the growing importance of the low-cost carrier. Richards (1996) articulates the importance of Southwest in routes less than 1000 miles in length. In a similar vein, Borenstein (1989) suggests that the impact of potential competition on prices is rather small. He observes that these potential competitors are not materially important for the 50<sup>th</sup> and above percentile airfares. The airline market has evolved since the mid 1990s and because low-cost carriers no longer only fly routes under 1000 miles in length it is important to determine the extent of the presence of low-cost carriers in the regional and long haul markets.

#### **Short/Long Haul Market Segment Equation**

$$\ln P_{ij} = \alpha_i + \beta_1 \ln \text{MKTDIST}_j + \gamma_1 \ln \text{LOADFAC}_{ij} + \gamma_2 \text{COUPON}_{ij} + \gamma_3 \ln \text{EQUIP}_{ij} + \gamma_4 \ln \text{FREQ}_{ij} + \delta_1 \ln \text{ORGSHARE}_{ij} + \delta_2 \ln \text{ORGHERF}_j + \delta_3 \text{RUTSHARE}_{ij} + \delta_4 \text{RUTHERF}_j + \delta_5 \ln \text{COMPCOST}_{ij} + \delta_6 \text{TOURIST}_j + \delta_7 \text{HUB}_j + \delta_8 \text{SLOT}_j + \delta_9 \text{MKTDISREG}_j + \delta_{10} \text{MKTDISLNG}_j$$

#### **Short/Long Haul Market Segment Equation with Low-Cost Variables**

$$\ln P_{ij} = \alpha_i + \beta_1 \ln \text{MKTDIST}_j + \gamma_1 \ln \text{LOADFAC}_{ij} + \gamma_2 \text{COUPON}_{ij} + \gamma_3 \ln \text{EQUIP}_{ij} + \gamma_4 \ln \text{FREQ}_{ij} + \delta_1 \ln \text{ORGSHARE}_{ij} + \delta_2 \ln \text{ORGHERF}_j + \delta_3 \text{RUTSHARE}_{ij} + \delta_4 \text{RUTHERF}_j + \delta_5 \ln \text{ORGLWCSHARE}_j + \delta_6 \text{LWCSTSHARE}_j + \delta_7 \text{LWCSTHERF}_j + \delta_8 \ln \text{COMPCOST}_{ij} + \delta_9 \text{TOURIST}_j + \delta_{10} \text{HUB}_j + \delta_{11} \text{LWCSSHUB}_j + \delta_{12} \text{SLOT}_j + \delta_{13} \text{MKTDISREG}_j + \delta_{14} \text{MKTDISLNG}_j$$

MKTDIST (market distance) is the nonstop distance measured in miles from one endpoint of a route to another. Longer routes should have higher prices; however, time spent cruising at altitude is proportionally higher on longer routes, which suggests that longer routes have a lower per mile cost. The higher per mile cost of short routes is due to the large amount of fuel that is burned during takeoff and landing. DISTANCE should be positive, but costs

increase proportionately more slowly as the route distance lengthens. The average flight distance on a major carrier is less than a low-cost airline. The median flight segment for the major carriers is 821.0 miles and is 866.0 miles for the low-cost carriers. However, the difference is small suggesting that neither the major nor low-cost carriers have a cost advantage from flying a much longer set of routes than other carrier group. Low-cost carriers may lower prices in markets and fly a high proportion of short haul flights. DISTANCE may not be significant when controlling for the presence of low-cost carriers, depending on whether the low-cost carrier or operating cost factor has a greater impact on price. At the time of the Borenstein (1989) article low-cost carriers had a diminutive presence in the United States.

Ceteris paribus a longer route should have a higher market price than a shorter route with the same characteristics. Longer routes require more fuel and are more costly to operate (on an absolute basis) compared to shorter routes. However, most of the fuel for a flight is burned during takeoff and landing. When the plane is at cruising altitude the fuel efficiency of the plane is higher. Hence longer transcontinental flights have a lower cost per mile than flights of 500 miles or less. As a result, an increased distance may not result in as large of an increase in price as initially thought. It is important to note that the dominant low-cost carrier, Southwest, primarily operates short haul routes, yet still charges lower fares than its competitors. Distance should explain a large percentage of the price level in a market, but in no way does distance explain the disparity in prices between carriers.

The transcontinental market illustrates this disparity suitably. JetBlue provides its product at a price that undercuts its competition by up to 75%. An unrestricted coach ticket from JFK to LAX on American or United costs approximately \$2500. In comparison, a comparable ticket on JetBlue costs \$598. This example also raises the possibility that past analyses have overestimated the impact of distance, because low-cost competition did not

exist on long haul routes until recently. Prior to low-cost competition, long haul prices may have had proportionally higher prices because airlines had more market power on the longer routes. The possible discrepancy in past analyses bolsters the importance of including variables in the price equation to control for the presence of low-cost carriers.

LOADFAC (load factor) is the mean load factor of all flights of an airline that serves the observed route. The per passenger cost of a flights decreases as the load factor rises, which suggests that LOADFAC has a negative coefficient. However, flights with high load factors tend to operate during peak travel times. Congestion during peak travel times raises the cost of a flight, both in terms of delays and increased personal needed to handle the banks of flights that arrive and depart within a small window of time. Congestion impacts low-cost carriers to a lesser degree, since these firms operate out of less crowded airports. The weakening correlation between congestion and load factor over the last decade would suggest that a higher load factor would lower prices. Due to the growing presence of low-cost carriers and the lower operating cost of full flights (on a per capita basis) the effect of LOADFAC is uncertain.

COUPON (mean market coupon) is the average number of connections (both on-plane and change-of-plane) of the observed carrier on the observed route. Thus a coupon of 0 would indicate a non-stop itinerary. Connections are undesirable, but raise the cost of the product. Thus the impact of COUPON on price is uncertain.

EQUIP (equipment) is the mean size of the planes on flights that carry passengers on the observed route and airline. Larger equipment tends to have lower operating costs on per passenger basis and operate more efficiently on longer routes. On the other hand, larger planes may be preferred by travelers. A preference for higher capacity aircraft may increase demand on routes with larger aircraft, which would in turn raise prices. Likewise, the major

carriers tend to operate a higher proportion of larger aircraft than the low-cost rivals. For this reason, a larger mean aircraft size may indicate higher prices.

FREQ (frequency) is the average frequency of flights available to passengers on the observed airline and route. Controlling for other factors, a higher frequency of flights raises the value of the product to the passenger. One would expect that this increased value leads to higher demand and finally higher prices. Higher frequency also allows airlines to operate aircraft more efficiently and lowers an airline's cost and ticket prices. Many carriers, including low-cost carriers, operate routes with a high frequency of service to achieve cost savings. Thus the estimated effect of FREQ on price is uncertain.

ORGSHARE (origin & dest. market share) is the weighted average of the observed airline's share of passenger originations at the two endpoints of a route. ORGSHARE is weighted by the ratio of passengers on the route who start their trips at the two endpoints divided by the total number of passengers, who originate travel at all endpoints. An increase in ORGSHARE may allow airlines to exercise greater market power and raise prices. Because the vast majority of flights still take place on hub-and-spoke carriers the coefficient of ORGSHARE may diverge from ORGLWCSHARE.

ORGHERF (origin & dest. Herfindahl) is the weighted average of the Herfindahl indexes of passengers' originations at the two endpoints of the observed route (measured from zero to one). The weighting of ORGHERF is the same as ORGSHARE. The competitive factors that provide an airline with increased market power correspond to a dominant carrier having many small competitors. However, an airline may prefer having a single larger competitor in order to facilitate illegal, but profitable collusion. Case in point, when American Airlines CEO Robert Crandall called Braniff International Airlines CEO Howard Putnam to collude, he suggested doing so would be easy due to their large shares of the market in

question.<sup>2</sup> Both competitive models can result in higher prices and as a result the effect of ORGHERF on fares is uncertain.

RUTSHARE (route market share) is the observed airline's share of passengers on the observed route (origin to destination traffic). Elementary economic theory would suggest that increased route share corresponds to increased market power, which results in higher prices for the consumer. One can expect that increased route share results in higher prices.

RUTHERF (route Herfindahl) is the Herfindahl index for passengers on the observed route (measured from zero to one). If the observed route has a small number of large participants, collusion may raise prices. However, if there is a dominant firm with a competitive advantage and many smaller participants, the dominant firm's pricing power may not extend to its competitors. The change in the percentile price on the observed route depends not only on the value of the Herfindahl index, but also on the competitive state of the dominant firm.

ORGLWCSHARE (low-cost origin & dest. market share) is a weighted average of low-cost carriers' share of the daily passengers at the endpoints of the route in question. The weighting is the same as ORGSHARE. Assuming increases in ORGSHARE will lead to increases in market power; increases in ORGLWCSHARE indicate that low-cost carriers transport a larger percentage of the passengers at the endpoint airports. Higher ORGLWCSHARE may lead to reduced levels of market power and lower prices.

LWCSTSHARE (low-cost route market share) is the share of all origin and destination passengers on that route transported by low-cost carriers. The larger the percentage of people transported by low-cost carriers the lower the airfare will likely be. Since RUTSHARE, which measures the importance of concentration levels, is also measured it may be the case that

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<sup>2</sup> This scenario is less likely to be viable now due to the extensive presence of price aggressive competitors. In particular low-cost carriers are unlikely to engage in collusion and may instead prefer to compete on price with higher cost incumbents.

RUTSHARE is no longer significant when LWCSTSHARE is included. This would indicate that low-cost route share, not general levels of route concentration, explain the movements in ticket prices.

LWCSTHREF (low-cost route Herfindahl) is the Herfindahl index (measured from zero to one) for the origin and destination passengers carried on low-cost carriers on a particular route. The measure is included to show the likely discrepancy between the normal Herfindahl index (RUTHREF) and this variable, which only measures the market share of low-cost carriers.

COMPCOST (comparable cost) is the weighted average of the cost per seat mile of every airline on the observed route other than the observed firm. Each carrier's share of passengers on the observed route determines its corresponding weighting. Clearly, each airline's system wide cost per seat mile only approximates the actual cost per seat mile on the observed route. If the marginal cost of its competitors rises, the observed carrier can raise prices without lowering its market share. However, the elasticity of COMPCOST (for a specific route) may be dependent on whether or not the observed airline is a low-cost carrier. As the market share of low-cost carriers has grown the elasticity of COMPCOST is likely to have fallen. As a result, COMPCOST may play a less significant role in the pricing equation than in the Borenstein (1989) analysis.

TOURIST (tourist route) measures the degree to which the observed route is a tourist or leisure route. TOURIST is a dummy variable set to 1 if one of the endpoints of the route is vacation oriented and 0 otherwise. This variable is critical to exposing the misconception that low-cost carriers only serve tourist oriented airports. Controlling for tourist oriented routes in the regression equation removes an important factor that might otherwise obscure the significance of the variables testing the significance of a low-cost carrier's presence. The

highly elastic demand curve on tourist routes suggests that TOURIST should have a negative coefficient.

**Table 2            Tourist Oriented Airports**

Airport	Airport Code
Aspen, Colorado	ASE
Fort Lauderdale International, Florida	FLL
Hilo International, Hawaii	ITO
Honolulu International, Hawaii	HNL
Palm Springs Metropolitan Area, California	PSP
Jacksonville International, Florida	JAX
Kahului Airport, Hawaii	OGG
Kona, Hawaii	KOA
Las Vegas Mccarran Intl, Nevada	LAS
Melbourne Intl, Florida	MLB
New Orleans International, Louisiana	MSY
Orlando International, Florida	MCO
Reno/Tahoe Int'l, Nevada	RNO
Tampa International, Florida	TPA
West Palm Beach International, Florida	PBI

Note: The compiled list of tourist airports is derived from Richards (1996).

HUB is a dummy variable equal to 1 if one of the endpoints of the observed route is a hub of a major carrier, and 0 otherwise. Note that the major carriers are limited in this analysis to American Airlines, United Airlines, Delta Airlines, and Continental Airlines. See below for a list of hub cities, segregated by major carrier. The analysis of Borenstein (1989) and others suggests that airlines wield higher levels of market power at hub airports. As a result consumers face higher prices for travel, if their route includes a hub airport at one of the endpoints. One expects that the sign of HUB will be positive.

**Table 3 Major Carrier Hubs**

Major Carrier	Domestic Hub Airports
American Airlines	Chicago O'Hare International – ORD Dallas Fort Worth – DFW Lambert St. Louis – STL Miami International – MIA San Juan Luis Muñoz Marin – SJU
Continental Airlines	Houston Intercontinental – IAH Newark International – EWR
Delta Airlines	Atlanta Hartsfield International – ATL Cincinnati Northern Kentucky – CVG Dallas Fort Worth – DFW Salt Lake City – SLC
United Airlines	Chicago O'Hare International – ORD Denver International Airport – DEN San Francisco International – SFO Washington Dulles – IAD

Note: The hubs for these four major carriers in the United States are self-reported. This list is built from airline documents taken from the corporate websites of each respective carrier.

LWCSHUB (low-cost hub at origin or dest.) is a dummy variable equal to 1 if one of the endpoints of the observed route is the hub of a low-cost carrier, and 0 otherwise. Dominant airlines tend to have a higher level of market power at a hub. However, a low-cost hub on an observed route may result in lower prices. A low-cost carrier's dominant presence may indicate that most of the airfares on the route are priced at a level set by the lowest cost producer. Instead of wielding traditional market power in order to raise profits, low-cost carriers compete on price in order to win market share.

**Table 4 Low-Cost Hubs**

Low-Cost Carrier	Hub Airports
JetBlue Airways	John F. Kennedy Airport – JFK Long Beach Airport – LGB
Southwest Airlines	Chicago Midway – MDW Dallas Love Field – DAL Phoenix Sky Harbor International – PHX

Note: Only Southwest and JetBlue have prominent hub airports. Hence, the primary airports for the other low-cost carriers are not included in this analysis. The hubs for these low-cost carriers are self-reported. This list is built from airline documents taken from the corporate websites of each respective carrier.

SLOT is a dummy variable equal to 1 if one of the endpoint airports of the observed route is a slot restricted airport and 0 otherwise. It should be noted that slot restrictions have been lifted at Chicago O'Hare, New York LaGuardia, and New York JFK. Slot restrictions are currently only in place at Reagan National Airport, which serves Washington D.C.

MKTDIS<sub>1j</sub>, MKTDIS<sub>2j</sub>, MKTDIS<sub>3j</sub>, MKTDIS<sub>4j</sub>, MKTDIS<sub>5j</sub>, MKTDIS<sub>6j</sub> (market distance). The MKTDIS variables control for the distance of a route with finer granularity than MKTDIST. Each of the six variables is a dummy variable that takes on the value 1 if the route length falls within the given MKTDIS variable's range and 0 otherwise. MKTDIS<sub>1</sub> refers to routes from 1 to 500 miles in length, MKTDIS<sub>2</sub> refers to routes from 501 to 1000 miles in length, MKTDIS<sub>3</sub> refers to routes from 1001 to 1500 miles in length, MKTDIS<sub>4</sub> refers to routes from 1501 to 2000 miles in length, MKTDIS<sub>5</sub> refers to routes from 2001 to 2500 miles in length, MKTDIS<sub>6</sub> refers to routes from 2501 to 3000 miles in length.

MKTDISREG (regional market distance group) variable is an indicator variable which takes on the value 1 when the observed route is between 1 and 1500 miles in length and 0 when the observed route is 1501 to 3000 miles in length. This variable along with MKTDISLNG may indicate the extent of low-cost carrier penetration. Low-cost carriers are a dominant force in the short haul market, but their impact may no longer be confined to this market segment. Since MKTDISREG and MKTDISLNG are perfectly collinear, MKTDISREG is excluded from the regression and serves as a baseline.

MKTDISLNG (long haul market distance group) variable is an indicator variable which takes on the value 1 when the observed route is between 1501 and 3000 miles in length and 0 when the observed route is 1 to 1500 miles in length. This variable along with MKTDISREG may point out the scope of low-cost carrier penetration. The MKTDISLNG

variable may serve as a proxy for the impact of low-cost carriers on long haul routes. Since MKTDISREG and MKTDISLNG are perfectly collinear, only MKTDISLNG is included in the regression.

Table 5 includes a comprehensive list of the airlines included in the dataset constructed for this analysis. Since the Databank 1B dataset is a 10% random sample of all ticket travel, the airlines included in Table 5 are randomly selected, with a weighting proportional to the market share of each carrier. The low-cost carrier designation is based on the definition of a low-cost carrier described in section 2 of this paper. That definition is not an industry standard, because there is no standard system for determining if an airline is a low-cost carrier. The definition included in this paper selects the major low-cost carriers, Frontier, Southwest, and JetBlue. Moreover, the other low-cost carriers are small in comparison and should not impact the estimated results in a significant manner.

The equations and methodology described in this section are used to determine whether low-cost carriers impact the distribution of prices in different segments of the airline market. The equations include a comprehensive set of parameters to estimate which factors influence the distribution of market prices. Controls for route specific characteristics are included to maximize the accuracy of the estimated equations. Moreover, these estimated equations will also establish whether including the low-cost parameters was warranted. If the low-cost variables are not significant the low-cost equations will resemble the baseline equations; otherwise, any differences between the two sets of equations may characterize what the effect of a low-cost presence is on fare distributions.

**Table 5 Comprehensive Carrier List**

Code	Carrier Name	Low-Cost	Code	Carrier Name	Low-Cost
9N	Trans States Airlines	No	NJ	Vanguard Airlines	Yes
AA	American Airlines	No	NK	Spirit Airlines	Yes
AQ	Aloha Airlines	No	OH	Comair	No
AS	Alaska Airlines	No	OW	OneWorld Alliance	No
B6	JetBlue Airways	Yes	PN	Pan America Airways	No
CO	Continental Airlines	No	SM	Sunworld Airlines	Yes
CS	Continental Micro	No	SY	Sun Country Airlines	Yes
DL	Delta Air Lines	No	TZ	America Trans Air	Yes
EV	Atlantic Southeast Airlines	No	UA	United Airlines	No
F9	Frontier Airlines	Yes	US	US Airways	No
G4	Allegiant Air	No	WN	Southwest Airlines	Yes
HA	Hawaiian Airlines	No	XJ	Mesaba Airlines	No
HP	America West Airlines	No	XP	Casino Express Airlines	Yes
JI	Midway Airlines	No	YX	Midwest Express Airlines	No
MQ	Simmons Airlines	No	ZW	Air Wisconsin	No
N7	National Airlines	Yes			

Note: Although Sunworld Airlines, Sun Country Airlines, and Casino Express Airlines are considered to be low-cost carriers in this analysis, each of these airlines primarily flies charter flights. Thus the impact of these carriers is not expected to be material to the results of this analysis.

## 6. Results

The results of this analysis bring up to date Borenstein's (1989) results and interpretations while providing insight into the impact of low-cost carriers on airfares, the market dynamics of short haul and long haul routes, and to what extent previous analyses overstate the importance of hubs and concentration. Tables 9 through 11 include the regression results for each of the 18 regressions. The upper half of Table 9 contains the baseline regression results, which are in large part consistent with Borenstein's results. At the 20<sup>th</sup>, 50<sup>th</sup>, and 80<sup>th</sup> percentile fares the Route Market Share (RUTSHARE) coefficient is significant at the 1% level. The low variation of the coefficient value over price indicates that route concentration provides pricing power to airlines at any fare level. Controlling for route specific characteristics, the equation estimates that a 1% increase in a carrier's share on a route results in an increase in prices between 0.15% and 0.20%. Of note is the narrow range

of the price impact. Borenstein (1989) estimates an analogous range of 0.03% to 0.22%. Thus the impact of route concentration is more prominent today at the lowest percentile fares.

The highest levels of route and endpoint airport concentration are often found on routes that originate or terminate at a major nationwide carrier's hub. Table 3 enumerates the primary hubs for each major carrier. The baseline equation estimates that the presence of a hub at either or both endpoints of a route raises prices between 6.7% and 29.5%. These coefficients in the 20<sup>th</sup>, 50<sup>th</sup>, and 80<sup>th</sup> percentile equations are significant at the 1% level. The effect of a hub is significant, large, and proportional to the fare level. *Ceteris paribus*, this equation predicts that a hub raises the median fare by 16.8%. The stronger effect of hubs on the higher end, 29.5% vs. 16.8% at the median, suggests that loyalty programs targeted at business travelers provide a hub carrier with increased market power. This result is consistent with Borenstein's (1989) hypothesis that travelers that purchase full fare tickets are more likely to participate in frequent flier programs.

In contrast, the origin and destination market share (ORGSHARE) has a negligible impact on ticket prices. At the 20<sup>th</sup> percentile fare, the result is significant at the 1% level. At the median price and 80<sup>th</sup> percentile the effect of origin and destination market share is not significant at the 10% level. The effect of origin and destination market share is not consistent and diverges from the equation Borenstein (1989) estimates. The growth in air traffic at secondary airports and the stagnation of traffic growth at the largest most concentrated airports is one possible explanation for the declining effect of origin and destination market share, especially at secondary airports.

The effect of a slot restricted airport (SLOT) parallels the hub effect.<sup>3</sup> The baseline equation estimates that a slot restricted airport at the origin or destination causes the 20<sup>th</sup>, 50<sup>th</sup>,

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<sup>3</sup> Borenstein (1989) does not include a parameter to measure whether airports are slot restricted. However, this parameter is included to highlight the effect of capacity constraints, in this case government enforced, on the marketplace.

and 80<sup>th</sup> percentile fares to rise 7.5%, 10.3%, and 22.2% respectively. The 80<sup>th</sup> percentile estimate is significant at the 1% level, while the median and 20<sup>th</sup> percentile estimates are statistically significant at the 5% and 10% levels respectively. The uniformly positive and increasing effect of slot constraints across airfares suggests that capacity constraints, whether imposed by the government or the market, reduce the ability of competitors to enter a market and discipline prices. More generally, this analysis proposes that capacity constraints hinder competitive entry and raise airfares.

The remaining set of estimated parameters is, with the exception of one parameter, consistent with expectations when significant. Tourist oriented routes (TOURIST) are expected to have airfares 11.3% lower than non-tourist routes at the median fare. While the signed relationship between TOURIST and HUB is reverse, the increases in magnitudes are parallel across types of fares. Tourist oriented routes differ from the baseline route the least at the lowest fare and the most at the highest fare. This estimated outcome agrees with the premise that tourist oriented routes carry a higher percentage of price sensitive tourists. Moreover, on these routes frequent flier programs do not markedly enhance the market dominance of the observed carrier.

The market distance parameter (MKTDIST) is positive and significant at the 1% level in each regressed equation. This estimated result is as expected; although longer routes are more efficient to operate on a per mile basis, a longer route is still more costly and as such necessitates a higher airfare. In the baseline equation load factor (LOADFAC) is negative and significant at the 1% level at the 80<sup>th</sup> percentile, negative and significant at the 10% level at the median, and is not significant at the 20<sup>th</sup> percentile fare. This relationship differs from Borenstein's results, in which LOADFAC is negative and only significant at the 20<sup>th</sup> percentile. However, the result of this analysis is consistent with the argument that higher load factors indicate efficient aircraft utilization, which lowers a carrier's cost and in turn prices.

Equipment (EQUIP) is estimated to effect each price percentile in a negative and significant (at the 1% level) manner. Larger equipment is more efficient to operate and allows an airline to lower fares.

The effect of the frequency of flights on a route (FREQ), served by a particular carrier, is positive and significant at the 1% level over each fare percentile. This estimate corroborates the argument that travelers with a high value of time (business travelers) will pay a premium for convenience. COMPCOST is not significant at any fare level, which suggests that the aggregate cost structure of the competition is similar to the observed carrier. The result of the 3 baseline estimates upholds the conclusion that *ceteris paribus*, routes with a single dominant carrier have higher prices. Moreover, market dominance of an airline is enhanced when that observed carrier controls a large percentage of a route's traffic and has a number of small competitors.

While Borenstein (1989) finds that potential competition has little if any disciplining affect on market prices, this analysis argues that low-cost carriers have a significant and far-reaching impact on the airline market.<sup>4</sup> The estimated baseline equations with low-cost variables, presented in the lower half of Table 9, reveal that the effect of a low-cost carrier is present at each percentile. The low-cost route market share (LWCSTSHARE) parameter is significant at the 1% level in the median and 80<sup>th</sup> percentile equations. A 1% rise in low-cost route market share lowers the median fare by 0.33% and the 80<sup>th</sup> percentile fare by 0.86%. The lack of significance at the lowest percentile suggests that this market segment is already competitive. Thus a low cost presence disciplines prices to the greatest extent on the least competitive city-route pairs.

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<sup>4</sup> It is important to note that Borenstein (1989) does not control for low-cost carriers. Instead, the paper controls for potential competition, which is not an accurate proxy for measuring the magnitude of low-cost presence. If the Borenstein had controlled for low-cost carriers the paper may have estimated lower magnitudes for the concentration and hub effects. Hence, the negligible effect of potential competition does not imply that low-cost carriers had little if any impact on the airline market in the late 1980s.

Both low-cost route and endpoint airport market share (estimated with the parameter ORGLWCSHARE) impact market prices. If low-cost carriers control 50% of the originating passengers at the two endpoints of a route this analysis estimates that the observed carrier's price would fall by 0.006%, 0.031%, and 0.033% for the 20<sup>th</sup>, median, and 80<sup>th</sup> percentiles respectively. Thus controlling for the observed carrier's share on the route, increases in low-cost market share, either on the route or at the endpoint airports, lower the median and highest prices by 5 times the magnitude of the low-end effect.

Controlling for low-cost route market share reveals a downward force on prices; however, the effect of a low-cost hub is not significant at any of the 3 fare levels. The lack of a negative and significant low-cost hub effect is not consistent with the other low-cost parameters. However, low-cost hubs are not exclusively served by low-cost carriers. For example, JetBlue's primary hub is at New York John F. Kennedy (JFK) airport. Since this is a major airport, with a large base of business travelers, the low-cost hub does not significantly affect the fares of flights terminating and originating the JFK.

The effect on price of the presence of a low-cost carrier, as explained above, is negative and significant. Moreover, having one large low-cost carrier or many smaller players on a route does not affect prices. The low-cost route Herfindahl is only significant at the 80<sup>th</sup> percentile, where a lower Herfindahl index (HHI) reduces the magnitude of the estimated effect of the low-cost route Herfindahl (LWCSTHERF) parameter. Thus a low-cost presence, not the structure of that presence is an important predictor of price.

The estimated baseline equation with low-cost variables also reveals that the low-cost effect extends to the concentration and route characteristic parameters as well. In fact, this analysis argues that the concentration effect and hub effect that Borenstein (1989) and others suggest are critical to understanding airline pricing are significantly less important than previously suggested. Case in point, the baseline equation estimates that the presence of a hub

at either or both endpoints of a route raises prices between 6.7% and 29.5%. Controlling for the presence of low-cost carriers, with the 4 low-cost variables, the estimated effect of a hub ranges from 0.9% to 10.0%. Thus at the low-end the hub effect fell by 87% and at the high-end the hub effect declined by 66%.

The sharp decline of the hub effect suggests that much of this effect is actually due to the lack of a low-cost presence. Low-cost carriers carry 11.3% of all domestic traffic originating and terminating at a major carrier's hub airport. In comparison, these airlines carry 52.4% of traffic that does not originate or terminate at a hub. The small hub market share results in a comparatively large decline in both the hub effect and the level of localized market dominance. In the estimated baseline equations with low-cost variables, the HUB variable is no longer significant in the 20<sup>th</sup> percentile equation; the HUB variable is significant at the 1% level in the median and 80<sup>th</sup> percentile equations. The low-cost impact on hubs is noteworthy, because 46.2% of all airline traffic originates and or terminates at a major carrier's hub. Thus understanding how low-cost carriers affect the hub effect provides some intuition for their impact on the larger airline market.

The estimated change in price associated with hubs is overstated; moreover, the effect of frequency and slot constraints on the market price is also over estimated. The estimated effect of the frequency of flights on a route (FREQ) is positive and significant at the 1% in every baseline and low-cost baseline equation. The coefficients of FREQ in the low-cost baseline equation are 0.07, 0.05, and 0.14 for the 20<sup>th</sup>, 50<sup>th</sup>, and 80<sup>th</sup> percentiles respectively. The addition on the 4 low-cost variables lowers the baseline equation's FREQ parameters by 25% at the 20<sup>th</sup> percentile, 55% at the median, and 42% at the 80<sup>th</sup> percentile. Thus the additional market power that carriers may derive from offering a high frequency of flights is significantly lower when a low-cost carrier is present on a route.

The effect of slot constraints on prices is over estimated. The estimated effect of the slot constraints on a route (SLOT) is not significant at the 10% level for each fare percentile in low-cost baseline equations. The baseline equation estimates that a slot restricted airport at the origin or destination causes the 20<sup>th</sup>, 50<sup>th</sup>, and 80<sup>th</sup> percentile fares to rise 6.8%, 11.2%, and 22.3% respectively. However, none of the SLOT coefficients are significant in low-cost baseline equations. Thus the additional market power that carriers may derive from barriers to entry, like slot constraints, are not material with the presence of a low-cost carrier. Moreover, the entire slot effect can be ascribed to the lack of a low-cost presence. STOPPED HERE

Including low-cost parameters in the baseline equation similarly lowers the magnitude of the EQUIP coefficients. Without a low-cost presence the downward effect of larger aircraft is overestimated. Thus the cost savings implied in EQUIP are lower than the baseline equation suggests. The effect of TOURIST is also overestimated in the baseline equation. The inclusion of low-cost controls lowers the absolute value of the TOURIST effect to between 11.3% and 25.2%. Thus a large percentage of the TOURIST effect is dependent upon a low-cost presence or lack thereof. Furthermore, this low-cost presence effect is of note because 29.4% of all traffic travels on tourist oriented routes. A comparatively higher low-cost market share is needed to induce a low-cost effect on a price sensitive market segment, whereas on relatively price insensitive routes, such as those originating and or terminating at a hub, a much lower market share is necessary. This hypothesis is consistent with the 40.6% market share low-cost carriers enjoy on tourist routes and 11.3% market share on (major carrier) hub routes.

The low-cost parameters have no material impact on the market distance (MKTDIS), route Herfindahl (RUTHERF), or the cost parameter (COMPCOST). Likewise, there is no significant change in the route market share (RUTSHARE) variable. Thus this paper's baseline equation does not overestimate the impact of route concentration on prices. The route

concentration effect continues to be strong and an important factor in estimating market prices. The stability of the route concentration effect contrasts sharply with the overestimated effects associated with hubs, airport concentration, slot constraints, etc.

The three estimated six segment distance equations quantify the change in market prices over 500 mile market segments. The inclusion of the 500 mile market distance dummy variables does not change the estimated coefficients for the variables described thus far. The baseline six segment distance equation, which does not contain low-cost variables, brings to light a rising price premium that is tightly coupled to a flight's length. A flight 501 to 1000 miles in length is estimated to have a price 1.3% higher than a flight of 1 to 500 miles in length, for the median fare. This analysis estimates effect of a 2501 to 3000 mile route over the baseline distance is a 40.7% increase in price, for the median fare. This positive relationship between price and distance also holds for the 20<sup>th</sup> and 80<sup>th</sup> percentile equations. It is important to note that this graduated increase appears to take a log linear form, which is at odds with the linear increase in route length that the indicator variables measure. The price of tickets on longer routes rises more quickly than the route length. Cost does not explain this relationship, longer flights operate more efficiently. However, the higher levels of major carrier concentration on longer routes may play an important role in this relationship.

The six segment distance equations with low-cost parameters quantify the low-cost effect within distinct 500 mile market segments. Across each fare type and each fare percentile the effect of the market distance on price is lower when controlling for the presence of low-cost carriers. The 501-1000 mile segment parameter is not significant at any fare percentile in the six segment equation with low-cost variables. The 1501-2000 mile parameter's level of significance falls as well. Likewise, the magnitude of the coefficients decline. At the median fare, in the 1201-2000 mile segment, the distance effect falls 39.7%. The baseline equation overstates the premium associated distance.

With the largest flattening of the price distribution is at the high end, the low-cost effect is greatest at the high end. The summary statistics in Table 6 refute the assertion that a large low-cost presence is required to significantly alter the distribution of airfares in a market segment. Longer routes, with a lower percentage of price sensitive passengers, require a smaller low-cost presence to compact and shift the price distribution down. This result has two implications. First, the lower market presence of low-cost carriers on longer routes implies that higher barriers to entry exist on longer routes. However, the late arrival of these carriers to the long haul market may also explain the market share distribution in Table 6. Second, shorter routes with already compact price distributions require a comparatively larger low-cost presence to discipline prices. The 6 market segment regressions establish that market distance is, on average, a less important predictor of price than initially thought.

**Table 6 Six Segment Market Share Summary Statistics**

Market Segment	Low-Cost Share	Hub Share <sup>5</sup>	Tourist Share <sup>6</sup>	Tourist Low-Cost Share <sup>7</sup>	Low-Cost Tourist Share <sup>8</sup>
0-500 miles	44.84%	53.63%	25.95%	46.25%	25.33%
501-1000 miles	27.24%	59.83%	26.22%	39.34%	38.92%
1001-1500 miles	28.73%	50.22%	42.47%	43.57%	60.18%
1501-2000 miles	21.42%	58.25%	24.30%	46.95%	43.81%
2001-2500 miles	18.89%	31.35%	34.01%	23.27%	41.33%
2502-3000 miles	11.94%	33.26%	34.88%	10.91%	30.55%

An important hypothesis of this paper is that the low-cost effect is quantifiable in the regional and the long haul market. In place of the 500 mile segmented distance variables two dummy variables are used to quantify these two market segments. This paper estimates that 82.9% of airline traffic is regional and the remainder is long haul. A representative long haul route, New York (JFK) to Los Angeles (LAX), is the most traveled long haul route in the

<sup>5</sup> These figures represent the percentage of flights that originate or terminate at a hub airport.

<sup>6</sup> The percentage of passengers in the respective market segment that originated or terminated a flight at a tourist oriented airport.

<sup>7</sup> This column summarizes the share of tourist passengers that low-cost carriers carry in the given market segment.

<sup>8</sup> The share of low-cost carrier passengers traveling to or from tourist oriented airports.

United States with a low-cost market share of 0.06%. American Airlines is the dominant carrier on the route with a market share of 46.3%. The most traveled regional route is Washington National (DCA) to New York LaGuardia (LGA). Delta Airlines has the highest market share on the route at 53.5%. Also, there is no low-cost presence on DCA to LGA. Although, the most prominent regional and long haul routes lack a nontrivial low-cost presence, the low-cost effect is significant in both the regional and long haul markets.

The long haul route with the highest number of low-cost passengers is Chicago Midway (MDW) to Las Vegas (LAS). The dominant carriers on this route include American Trans Air with 43.1%, National Airlines with 31.0%, and Southwest with a 25.8% market share. In fact, low-cost carriers transport 100% of the traffic on this tourist oriented route. In the regional market, the most traveled route with a low-cost presence is Los Angeles (LAX) to Oakland (OAK). Southwest dominates this regional route with a market share of 92.6%; Southwest is the only low-cost carrier on the route. Even though the market structure for these example routes is vastly different, the low-cost impact is just as great. The low-cost presence itself not the structure of that presence, on long haul and regional routes, lowers prices.

The short/long haul market segment equations indicate that the low-cost effect extends across the entire airline market; moreover this effect is significant at each measured fare percentile. Note that the effects of the other parameters discussed previously remain the same unless otherwise noted. The estimated results of the three baseline short/long haul equations demonstrate the monetary premium associated with long haul routes. Case in point, the effect of the long haul market distance group variable on price is estimated to be 0.06, 0.16, and 0.14 at the 20<sup>th</sup>, 50<sup>th</sup>, and 80<sup>th</sup> percentiles respectively. Thus, at the median airfare, a long haul route is estimated to have a price 16% higher than a regional route controlling for route specific characteristics.

The result at the median mirrors the results at the 20<sup>th</sup> and 80<sup>th</sup> percentiles; moreover, each of the long haul market distance group (MKTDISLNG) parameters is significant at the 1% level. Thus there is a considerable price premium associated with the long haul market that cannot be explained by the higher total (though lower per mile) cost of long haul routes. A possible explanation for the price premium is that low-cost carriers have a much smaller exposure to the long haul market than the regional market. This lower market penetration rate triggers a lower level of competitive pressure on the incumbent major carriers, which in turn raises prices.

The price difference between regional and long haul routes at each of the three measured fare percentiles is overstated in the baseline equations. At the 20<sup>th</sup>, 50<sup>th</sup>, and 80<sup>th</sup> percentiles the long haul distance effect (the price premium over a comparable regional route) is estimated to be 4.8%, 9.7%, and 4.3% in the low-cost equations. The 20<sup>th</sup> and 80<sup>th</sup> percentile coefficients are significant at the 10% level and the median coefficient is significant at the 1% level. Not only has the estimated magnitude of each MKTDISLNG variable fallen, but the level of significance has fallen as well. The declining level of significance indicates that the difference in regional and long haul prices are of a lesser degree than the baseline equations imply.

An implication of the short/long haul equation results is that there is a difference in pricing between regional and short haul routes regardless of a low-cost presence; however, the more important observation is that low-cost carriers significantly lower the difference in prices between regional and long haul routes. Thus the low-cost carrier is no longer pigeon holed to the regional market; however, the regional market still accounts for 83.2% of all airline traffic. The three largest long haul low-cost carriers Southwest, America Trans Air, and JetBlue account for 75.4% of all long haul low-cost traffic. Table 8 summarizes the low-cost carriers that serve the long haul market and provides each carrier's market share.

Southwest is the largest low-cost carrier in the regional and long haul markets. JetBlue is only the third largest low-cost carrier. A carrier's share of low-cost traffic may be proportional to that carrier's share of the low-cost effect. Thus much of the low-cost effect on MKTDISLNG, HUB, SLOT, FREQ, and ORGSHARE is due to Southwest and not JetBlue.

**Table 7 Low-Cost Airline Market Share in Various Market Segments**

Airline	Low-Cost Market	Regional Market	Long Haul Market	Entire Market
JetBlue Airways	15.70%	1.63%	3.38%	3.12%
Frontier Airlines	3.56%	0.76%	0.87%	0.71%
National Airlines	14.18%	0.41%	3.05%	2.82%
Vanguard Airlines	0.69%	0.52%	0.14%	0.14%
Spirit Airlines	5.46%	1.58%	1.17%	1.08%
Sun Country Airlines	0.51%	0.15%	0.11%	0.10%
America Trans Air	17.07%	2.03%	3.65%	3.39%
Southwest Airlines	42.65%	28.71%	9.11%	8.47%

Low-cost carriers carry only 21.5% of all long haul traffic; however, the impact of these airlines on the pricing structure of the long haul market is large and significant. Competitive entry does not have to be large, but has to be low-cost to affectively discipline prices in the long haul market. Moreover, low-cost carriers only carry one fifth of all long haul traffic, but their presence or lack thereof explains 29% to 68% of the market distance effect measured by MKTDISLNG. This analysis argues that the estimated effect of a low-cost presence must be taken into account in order to derive an accurate understanding of the current state of the airline industry. Not taking into account the low-cost presence in a marketplace results in an overestimation of the estimated effect of critical market factors, such as airport concentration, hub presence, and flight frequency on the distribution of prices.

## 7. Conclusion

In the current airline market, the impact of a new breed of air carrier, the low-cost carrier, on airfares, is significant and broadly distributed. Previous industrial organization literature argues that concentration measures are critical to understanding the dynamics of pricing in the airline markets. The previous analyses of Borenstein (1989) and others lacked a key insight: the low-cost carrier is an important market participant. However, the Borenstein paper lays a solid groundwork that forms the base of this thesis. Without the low-cost parameters in the 3 sets of equations, the estimated results of this paper closely resemble Borenstein's results. The inclusion of the low-cost parameters in the baseline equation results in a set of estimated results that provide a more accurate accounting of what factors really impact airline industry price distributions and more specifically the prices that each consumer pays.

The low-cost effect results in the compaction of price distributions and the lowering of the associated central tendency of those distributions across all market segments. Moreover, a low-cost presence is correlated with a higher degree of competitiveness and a decline in the relevance of concentration, frequency, hubs, and capacity constraints in predicting market prices. The low-cost effect is statistically significant and measurable across the entire distribution of airfares. The effect is also significant and measurable for a route of variable length. A low-cost presence lowers prices at the low end, median, and high-end of the price distribution on regional and long haul routes. In fact, the largest degree of flattening occurs at the high end of the price distribution. Thus routes with the highest levels of market dominance would experience the largest change in their distribution of prices, with the entry of a low-cost carrier.

Moreover, a low-cost presence is estimated to cause a flatter price distribution, a higher degree of competitiveness, and a decline in the relevance of concentration, frequency,

hubs, and capacity constraints in predicting market prices. This new breed of air carrier disciplines the incumbent major carriers that rely on market dominance to extract higher rents to support the higher cost basis of the hub-and-spoke networks these airlines use. The disciplining effect of low-cost carriers on the premium major airlines derives from hub airports may indicate that the higher cost basis of a traditional hub is no longer justified. Moreover, the low-cost airline model, which is built around using a point-to-point network, should continue to be a successful model for new entrants. While it is unlikely that any major carriers will completely abandon their hub-and-spoke networks, the partial dismantling of those hubs, in the form of de-peaking, will continue. Market forces have and will continue to cause these structural changes. Furthermore, there are policies can accelerate this shift and the magnitude of the low-cost presence in the airline markets.

This paper argues that a shift in critical thought is necessary to analyze today's airline industry; moreover, policies to encourage competition and a flatter price distribution will only bring about change if these policies are designed to encourage a larger low-cost presence in the marketplace. Policies that try to reduce concentration levels or dismantle hub airports will face stiff political opposition. The estimated baseline results suggest that regulations targeting these factors would change the distribution of airfares. In reality, the concentration and hub effects are significantly smaller than this paper first proposes. Targeting these factors would not result in a dramatic change in the competitiveness of airline routes as measured by the shape and location of the fare distribution curve. Moreover, this kind of targeted policy would incite fierce lobbying by the major nationwide carriers. The recent success of these carriers to obtain multi-billion dollar subsidies from the federal government points to the strength of the corporate airline lobby and airline union lobby.

Given that traditional policies, which encourage lower levels of concentration, are relatively ineffectual and politically infeasible, is there a viable alternative? Instead of

attempting to reduce the impact of factors with a negative effect on the market, a successful policy must try to raise the impact of factors with a positive effect on the market. A viable policy must provide ample opportunity for low-cost entry in order to compact the fare distribution and return rents to the American consumer. The primary barrier to low-cost entry is the lack of airport infrastructure at many of America's largest metropolitan airports. In order to achieve the disciplining effect of a low-cost presence, the government should implement policies that encourage capacity constrained airports to build new infrastructure. Moreover, regulatory barriers to airport expansion should be loosened. A lower level of airport expansion regulation would encourage airports to undertake needed infrastructure improvements to increase capacity.

A build out of airport infrastructure, targeted at the most congested airports, would encourage low-cost carriers to enter a greater number of non-secondary markets. The newly constructed airport resources need to be allocated so that incumbent carriers do not receive a preferential claim to those resources. New resources alone do not discipline markets and compact the price distribution. Low-cost carriers must have access to those resources; otherwise, the infrastructure projects are nothing more than a subsidy to the major carriers. With greater access to once congested markets, the low-cost effect, on the market price distribution in these congested markets, should continue to increase in magnitude. Although, hubs still have higher fares than other airports, even when controlling for low-cost carriers, the significant role of the low-cost carrier in today's airline market indicates that dominance and market power do not go unchecked in the U.S. airline industry; moreover, this paper estimates that the entry of a low-cost carrier lowers fares while at the same time it lessens the effect of concentration and increases competition in the U.S. airline industry.

## 8. Regression Tables

**Table 8 – Baseline Equations**

Baseline Equation Dependent Variable:	20th Percentile Price (ln)			50th Percentile Price (ln)			80th Percentile Price (ln)		
	Beta	Std.	Sig.	Beta	Std.	Sig.	Beta	Std.	Sig.
		Error			Error			Error	
(Constant)	2.395	0.147	0.000	3.425	0.135	0.000	3.424	0.153	0.000
Market Distance (ln)	0.330	0.011	0.000	0.247	0.010	0.000	0.336	0.012	0.000
Mean Market Coupons	0.045	0.042	0.287	0.162	0.039	0.000	0.235	0.044	0.000
Load Factor (ln)	-0.008	0.020	0.680	-0.033	0.018	0.074	-0.084	0.021	0.000
Equipment (ln)	-0.065	0.017	0.000	-0.127	0.016	0.000	-0.215	0.018	0.000
Frequency (ln)	0.083	0.018	0.000	0.143	0.016	0.000	0.266	0.018	0.000
O & D Market Share (ln)	-0.041	0.009	0.000	-0.020	0.008	0.013	0.014	0.009	0.115
O & D Herfindahl (ln)	0.057	0.015	0.000	0.015	0.014	0.265	-0.021	0.015	0.171
Route Market Share	0.159	0.038	0.000	0.197	0.035	0.000	0.200	0.040	0.000
Route Herfindahl	0.033	0.046	0.477	-0.001	0.043	0.981	0.081	0.048	0.093
Comparable Cost (ln)	-0.006	0.008	0.417	0.002	0.007	0.806	0.005	0.008	0.532
Tourist Route	-0.071	0.018	0.000	-0.113	0.017	0.000	-0.234	0.019	0.000
Hub Airport	0.067	0.015	0.000	0.168	0.014	0.000	0.295	0.016	0.000
Slot Restricted Airport	0.075	0.052	0.151	0.103	0.048	0.034	0.222	0.055	0.000

Baseline Equation with Low-Cost Variables Dependent Variable:	20th Percentile Price (ln)			50th Percentile Price (ln)			80th Percentile Price (ln)		
	Beta	Std.	Sig.	Beta	Std.	Sig.	Beta	Std.	Sig.
		Error			Error			Error	
(Constant)	2.416	0.148	0.000	3.270	0.132	0.000	3.262	0.143	0.000
Market Distance (ln)	0.332	0.011	0.000	0.248	0.010	0.000	0.338	0.011	0.000
Mean Market Coupons	0.027	0.042	0.512	0.141	0.037	0.000	0.189	0.041	0.000
Load Factor (ln)	-0.004	0.020	0.827	-0.021	0.018	0.235	-0.066	0.019	0.001
Equipment (ln)	-0.041	0.018	0.022	-0.053	0.016	0.001	-0.103	0.017	0.000
Frequency (ln)	0.058	0.018	0.001	0.068	0.016	0.000	0.155	0.018	0.000
O & D Market Share (ln)	-0.043	0.009	0.000	-0.032	0.008	0.000	-0.001	0.008	0.931
O & D Herfindahl (ln)	0.086	0.017	0.000	0.108	0.015	0.000	0.084	0.016	0.000
Route Market Share	0.154	0.038	0.000	0.175	0.034	0.000	0.161	0.037	0.000
Route Herfindahl	0.047	0.049	0.343	0.001	0.044	0.983	0.037	0.048	0.445
Low-Cost O & D Share (ln)	-0.013	0.005	0.018	-0.061	0.005	0.000	-0.065	0.005	0.000
Low-Cost Route Share	-0.096	0.085	0.259	-0.335	0.076	0.000	-0.863	0.083	0.000
Low-Cost Route Herfindahl	-0.052	0.099	0.602	0.098	0.089	0.268	0.467	0.097	0.000
Comparable Cost (ln)	-0.006	0.008	0.434	-0.001	0.007	0.846	0.002	0.008	0.830
Tourist Route	-0.063	0.019	0.001	-0.080	0.017	0.000	-0.175	0.018	0.000
Hub Airport	0.009	0.017	0.600	0.042	0.016	0.007	0.100	0.017	0.000
Low-Cost Hub	-0.040	0.024	0.098	-0.001	0.022	0.953	-0.015	0.024	0.520
Slot Restricted Airport	0.036	0.053	0.487	0.007	0.047	0.884	0.067	0.051	0.193

**Table 9 – Short/Long Haul Market Segment Equations**

<b>Short/Long Haul Market Segment Equation</b>									
Dependent Variable:	20th Percentile Price (ln)			50th Percentile Price (ln)			80th Percentile Price (ln)		
	Beta	Std. Error	Sig.	Beta	Std. Error	Sig.	Beta	Std. Error	Sig.
(Constant)	2.534	0.151	0.000	3.708	0.139	0.000	3.651	0.157	0.000
Market Distance (ln)	0.308	0.013	0.000	0.201	0.012	0.000	0.298	0.013	0.000
Mean Market Coupons	0.045	0.042	0.283	0.157	0.039	0.000	0.238	0.044	0.000
Load Factor (ln)	-0.010	0.020	0.615	-0.036	0.018	0.049	-0.086	0.021	0.000
Equipment (ln)	-0.070	0.017	0.000	-0.137	0.016	0.000	-0.222	0.018	0.000
Frequency (ln)	0.089	0.018	0.000	0.154	0.016	0.000	0.274	0.018	0.000
O & D Market Share (ln)	-0.037	0.009	0.000	-0.014	0.008	0.075	0.018	0.009	0.042
O & D Herfindahl (ln)	0.051	0.015	0.001	0.004	0.014	0.787	-0.029	0.015	0.062
Route Market Share	0.145	0.038	0.000	0.171	0.035	0.000	0.185	0.040	0.000
Route Herfindahl	0.028	0.046	0.551	-0.003	0.043	0.942	0.081	0.048	0.093
Comparable Cost (ln)	-0.008	0.008	0.317	-0.001	0.007	0.836	0.003	0.008	0.696
Tourist Route	-0.077	0.018	0.000	-0.117	0.017	0.000	-0.236	0.019	0.000
Hub Airport	0.067	0.015	0.000	0.172	0.014	0.000	0.300	0.016	0.000
Slot Restricted Airport	0.079	0.052	0.132	0.111	0.048	0.022	0.229	0.054	0.000
Long Haul Market Group	0.068	0.023	0.004	0.158	0.021	0.000	0.135	0.024	0.000

<b>Short/Long Haul Market Segment Equation with Low-Cost Variables</b>									
Dependent Variable:	20th Percentile Price (ln)			50th Percentile Price (ln)			80th Percentile Price (ln)		
	Beta	Std. Error	Sig.	Beta	Std. Error	Sig.	Beta	Std. Error	Sig.
(Constant)	2.531	0.153	0.000	3.454	0.136	0.000	3.326	0.149	0.000
Market Distance (ln)	0.316	0.013	0.000	0.220	0.012	0.000	0.327	0.013	0.000
Mean Market Coupons	0.029	0.042	0.490	0.140	0.038	0.000	0.198	0.041	0.000
Load Factor (ln)	-0.006	0.020	0.758	-0.023	0.018	0.193	-0.066	0.019	0.001
Equipment (ln)	-0.049	0.018	0.007	-0.063	0.016	0.000	-0.105	0.018	0.000
Frequency (ln)	0.067	0.018	0.000	0.078	0.016	0.000	0.157	0.018	0.000
O & D Market Share (ln)	-0.040	0.009	0.000	-0.028	0.008	0.000	0.000	0.009	0.997
O & D Herfindahl (ln)	0.077	0.017	0.000	0.096	0.015	0.000	0.082	0.016	0.000
Route Market Share	0.144	0.038	0.000	0.162	0.034	0.000	0.163	0.037	0.000
Route Herfindahl	0.041	0.049	0.408	-0.002	0.044	0.970	0.037	0.048	0.447
Low-Cost O & D Share (ln)	-0.009	0.006	0.109	-0.057	0.005	0.000	-0.064	0.005	0.000
Low-Cost Route Share	-0.087	0.085	0.308	-0.322	0.076	0.000	-0.858	0.083	0.000
Low-Cost Route Herfindahl	-0.053	0.099	0.596	0.098	0.089	0.267	0.468	0.097	0.000
Comparable Cost (ln)	-0.007	0.008	0.378	-0.003	0.007	0.680	0.002	0.008	0.797
Tourist Route	-0.070	0.019	0.000	-0.086	0.017	0.000	-0.177	0.018	0.000
Hub Airport	0.014	0.018	0.433	0.051	0.016	0.001	0.105	0.017	0.000
Low-Cost Hub	-0.045	0.025	0.064	-0.010	0.022	0.644	-0.019	0.024	0.428
Slot Restricted Airport	0.043	0.053	0.410	0.017	0.047	0.719	0.071	0.051	0.164
Long Haul Market Group	0.048	0.024	0.044	0.097	0.021	0.000	0.043	0.023	0.062

**Table 10 – Six-Segment Distance Equations**

**Six-Segment Distance Equation**

Dependent Variable:	20th Percentile Price (ln)			50th Percentile Price (ln)			80th Percentile Price (ln)		
	Beta	Std. Error	Sig.	Beta	Std. Error	Sig.	Beta	Std. Error	Sig.
(Constant)	2.814	0.184	0.000	3.923	0.169	0.000	3.825	0.190	0.000
Market Distance (ln)	0.261	0.022	0.000	0.169	0.020	0.000	0.274	0.023	0.000
Mean Market Coupons	0.035	0.042	0.408	0.150	0.039	0.000	0.233	0.043	0.000
Load Factor (ln)	-0.011	0.020	0.567	-0.037	0.018	0.040	-0.087	0.020	0.000
Equipment (ln)	-0.074	0.017	0.000	-0.144	0.016	0.000	-0.230	0.018	0.000
Frequency (ln)	0.092	0.018	0.000	0.160	0.016	0.000	0.281	0.018	0.000
O & D Market Share (ln)	-0.035	0.009	0.000	-0.010	0.008	0.209	0.025	0.009	0.007
O & D Herfindahl (ln)	0.049	0.015	0.001	0.001	0.014	0.948	-0.032	0.015	0.035
Route Market Share	0.138	0.038	0.000	0.162	0.035	0.000	0.173	0.040	0.000
Route Herfindahl	0.031	0.046	0.499	0.011	0.043	0.802	0.107	0.048	0.026
Comparable Cost (ln)	-0.009	0.008	0.228	-0.003	0.007	0.650	0.002	0.008	0.806
Tourist Route	-0.082	0.018	0.000	-0.119	0.017	0.000	-0.236	0.019	0.000
Hub Airport	0.068	0.015	0.000	0.180	0.014	0.000	0.311	0.016	0.000
Slot Restricted Airport	0.078	0.052	0.136	0.112	0.048	0.020	0.230	0.054	0.000
501-1000 mile Market	0.047	0.027	0.074	0.013	0.024	0.602	0.005	0.027	0.867
1001-1500 mile Market	0.103	0.038	0.007	0.076	0.035	0.029	0.046	0.039	0.242
1501-2000 mile Market	0.125	0.047	0.008	0.141	0.043	0.001	0.055	0.049	0.259
2001-2500 mile Market	0.250	0.055	0.000	0.282	0.050	0.000	0.265	0.057	0.000
2501-3000 mile Market	0.138	0.070	0.047	0.407	0.064	0.000	0.473	0.072	0.000

**Six-Segment Distance Equation with Low-Cost Variables**

Dependent Variable:	20th Percentile Price (ln)			50th Percentile Price (ln)			80th Percentile Price (ln)		
	Beta	Std. Error	Sig.	Beta	Std. Error	Sig.	Beta	Std. Error	Sig.
(Constant)	2.756	0.186	0.000	3.606	0.166	0.000	3.365	0.181	0.000
Market Distance (ln)	0.278	0.022	0.000	0.198	0.020	0.000	0.325	0.022	0.000
Mean Market Coupons	0.020	0.042	0.640	0.135	0.038	0.000	0.197	0.041	0.000
Load Factor (ln)	-0.007	0.020	0.721	-0.024	0.018	0.170	-0.067	0.019	0.000
Equipment (ln)	-0.052	0.018	0.004	-0.070	0.016	0.000	-0.112	0.018	0.000
Frequency (ln)	0.069	0.018	0.000	0.085	0.016	0.000	0.164	0.018	0.000
O & D Market Share (ln)	-0.038	0.009	0.000	-0.025	0.008	0.001	0.003	0.009	0.733
O & D Herfindahl (ln)	0.075	0.017	0.000	0.092	0.015	0.000	0.077	0.016	0.000
Route Market Share	0.139	0.038	0.000	0.157	0.034	0.000	0.159	0.037	0.000
Route Herfindahl	0.041	0.050	0.406	0.007	0.044	0.877	0.052	0.048	0.284
Low-Cost O & D Share (ln)	-0.009	0.006	0.104	-0.055	0.005	0.000	-0.062	0.005	0.000
Low-Cost Route Share	-0.078	0.086	0.365	-0.287	0.077	0.000	-0.814	0.084	0.000
Low-Cost Route Herfindahl	-0.057	0.100	0.566	0.067	0.089	0.455	0.426	0.097	0.000
Comparable Cost (ln)	-0.008	0.008	0.284	-0.004	0.007	0.527	0.001	0.008	0.869
Tourist Route	-0.076	0.019	0.000	-0.091	0.017	0.000	-0.179	0.019	0.000
Hub Airport	0.015	0.018	0.402	0.058	0.016	0.000	0.115	0.017	0.000
Low-Cost Hub	-0.050	0.025	0.043	-0.013	0.022	0.558	-0.018	0.024	0.442
Slot Restricted Airport	0.043	0.053	0.413	0.021	0.047	0.657	0.075	0.051	0.140
501-1000 mile Market	0.035	0.027	0.188	0.003	0.024	0.912	-0.019	0.026	0.471
1001-1500 mile Market	0.089	0.038	0.020	0.061	0.034	0.075	0.012	0.037	0.757
1501-2000 mile Market	0.102	0.048	0.032	0.105	0.043	0.013	-0.004	0.046	0.926
2001-2500 mile Market	0.198	0.056	0.000	0.170	0.050	0.001	0.074	0.054	0.175
2501-3000 mile Market	0.061	0.071	0.390	0.223	0.063	0.000	0.159	0.069	0.021

**Table 11 – Summary Statistics for the Regression Equations**

Dependent Variable: Price	20th		50th		80th	
	R <sup>2</sup>	N	R <sup>2</sup>	N	R <sup>2</sup>	N
Baseline Equation	0.259	16,746	0.219	16,746	0.331	16,746
Baseline Equation (Low-Cost)	0.269	16,746	0.281	16,746	0.424	16,746
Six Segment Equation	0.255	16,746	0.230	16,746	0.343	16,746
Six Segment Equation (Low-Cost)	0.263	16,746	0.278	16,746	0.424	16,746
Short/Long Haul Equation	0.252	16,746	0.223	16,746	0.333	16,746
Short/Long Haul Equation (Low-Cost)	0.260	16,746	0.276	16,746	0.422	16,746

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