Analyzing the Effects of a Merger between Airline Codeshare Partners

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Abstract

In October 2008, the Department of Justice approved the Delta/Northwest merger, claiming the potential for substantial cost efficiencies with little or no harmful effects on competition. What makes this merger particularly interesting is that Delta and Northwest are codeshare partners. As such, the merger could have varying effects across different product types (pure online versus codeshare). Using pre-merger data and a structural econometric model, we analyze the potential effects of this merger. We find that predicted percent price increases for Delta and Northwest codeshare products are larger than the predicted percent increases for their pure online products.

K*eywords:* Merger Analysis; Codeshare Alliance; Airline Competition
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1. Introduction

Market power is often studied in the microeconomic literature for various reasons. Industries with high concentration ratios tend to have higher markups and profits due to the firms' ability to set higher prices. Of particular interest in this field are mergers and their effects. When a merger occurs, the market will become more concentrated, but the effects aren't always the same – a merger could be harmful by greatly decreasing competition, increasing prices, and heightening entry barriers. However, a merger may also create cost efficiencies – if costs decrease for a firm, lower prices may follow, which can be beneficial for competition.

Although there was much speculation as far back as February 2008 about a possible merger between the two firms,[1] Delta officially announced its plans to acquire Northwest on April 14, 2008.[2] The combined carrier plans to operate under the Delta name, be headquartered in Atlanta, and operate the nine hubs of both airlines in the U.S., Europe, and Asia.

Critics believe that the merger will cause significant price increases and may even initiate other large airline mergers, eventually leading to an industry with less than 5 main competitors. On May 14th, 2008, Minnesota Democratic Congressman James Oberstar stated that "This should not be and must not be considered a standalone, individual transaction but rather as the trigger of what will surely be a cascade of subsequent mergers that will consolidate aviation in the United States and around the world into global, mega carriers."[3] If true, this (according to microeconomic theory) could lead to higher markups and prices if market power could be exercised.

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[1] Atlanta Journal-Constitution.
http://www.ajc.com/business/content/business/delta/stories/2008/02/16/delta_0217.html
[2] CNN Money.
http://money.cnn.com/2008/04/14/news/companies/delta_northwest/index.htm
[3] CNN Money.
http://money.cnn.com/2008/05/14/news/companies/airline_merge/index.htm?postversion=2008051418

Proponents, specifically the airlines, must show that the merger will have positive effects, and that the positive effects will outweigh any negative effects such as price increases. If two firms wanting to merge can show benefits of the merger – such as cost efficiencies and increased quality of service – the merger has a greater chance of getting approved by the U.S. Department of Justice (DoJ).[4]

On August 6th, 2008, the European Commission gave unconditional clearance for the merger. The Commission stated that the merger would not impede effective competition in Europe or the trans-Atlantic. Further, a new development occurred less than two months later on September 25th when the stockholders of the two companies "overwhelmingly approved" the merger. [5] After the shareholders approved, the legal processes continued, and it was up to the DoJ to examine the situation to see if the merger would be permitted.

On October 29th, 2008, the DoJ approved the Delta/Northwest merger, stating that "the Division has determined that the proposed merger between Delta and Northwest is likely to produce substantial and credible efficiencies that will benefit U.S. consumers and is not likely to substantially lessen competition".[6] Now that the merger is approved, the airlines can begin to integrate. The integration process will take place over a period of 12 – 24 months, beginning in early 2009.[7]

We use a well-known structural econometric framework[8] to estimate the potential market effects of the imminent Delta/Northwest merger in markets where their services overlap prior to the merger. Specifically, we use pre-merger data to estimate demand, then use the demand

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[4] DoJ Horizontal Merger Guidelines. http://www.usdoj.gov/atr/public/guidelines/horiz_book/4.html
[5] Delta Press Release
http://news.delta.com/article_display.cfm?article_id=11162
[6] Department of Justice Press Release
http://www.usdoj.gov/atr/public/press_releases/2008/238849.htm
[7] Delta Press Release
http://news.delta.com/article_display.cfm?article_id=11176
[8] For examples, see Nevo (2000) and Ivaldi and Verboven (2005).

parameter estimates along with an assumed price-setting behavior (Bertrand-Nash) of airlines to recover product-level marginal costs. With the product-level marginal costs and demand estimates in hand, we use the multiproduct firm Bertrand-Nash pricing framework to conduct counterfactual experiments. One counterfactual experiment we ran is to compute the extent to which Delta and Northwest product prices might increase in the worst case scenario in which the merger does not produce any efficiency gains.

This merger is of particular interest because Delta and Northwest are codeshare partners. With codesharing, a trip is ticketed by a single carrier, even though some (or all) of the flights on the passenger itinerary are operated by a different carrier, which is the codeshare partner. This is different from a pure online flight itinerary, in which the trip is ticketed and operated by the same carrier. [9]

There is a growing body of literature that analyzes airline mergers and the effects they have on market power and airline fares. Beutel and McBride (1992) illustrate a direct econometric method to estimate the change in market power caused by a merger. Their results show that a merger may have very different quantitative effects for the firms involved based on pre-merger market power. Singal (1996) studies the pricing behavior of airlines following mergers that occurred in the 1980's. Morrison (1996) uses a unique dataset to analyze long term trends and effects of mergers by looking 7 years before and after a merger occurs, paying special attention to routes that were served by both carriers before the merger. For the three mergers studied, fares for the newly merged firm increased immediately after the merger, but fell over time to levels at or below competitors' fares. Competition on the routes was always higher prior to the mergers. Clougherty (2006) studies domestic mergers, but argues that these mergers are driven by international competition incentives as well as domestic competition incentives. He

[9] Formal definitions of codeshare and pure online products are given in Section 2.

finds that domestic mergers lead to an increased international competitive performance due to network enhancement and network consolidation effects. Peters (2006) uses a counterfactual simulation method similar to ours in order to predict price increases resulting from five airline mergers that occurred in the 1980s, and compares the predicted price increases to actual price increases. The post-merger data allowed differences in predicted price changes and actual price changes to be decomposed. He finds that unobservable supply-side factors, namely changes in marginal costs and deviations from the assumed model of firm conduct, play a large role in post-merger price increases.

Other literature has studied the effects of alliances, but with the exception of Ito and Lee (2007) and Gayle (2008), these studies do not address the different types of products associated with codesharing. Adler and Smilowitz (2007) demonstrate a basic framework assuming competitive markets and minimal regulation that allows airlines to choose both international network structure and alliances. They find that both alliances and mergers have a positive effect for partners involved but damaging effects for an airline that fails to find an alliance or merger partner.

Finally, there is a relatively small portion of the literature that explicitly analyzes codesharing. Bilotkach (2007) examines airline consolidation (defined as forming an alliance and codesharing) using transatlantic markets to inspect if codesharing with and without antitrust immunity decreases fares for interline trips equally. The results show that codesharing and alliance-forming both have fare-decreasing effects, but the codesharing effect is more than twice the magnitude of the alliance effect. As noted in Brueckner and Whalen (2000) and Brueckner (2003), codesharing allows airlines to eliminate a double markup on itineraries with multiple operators, resulting in lower fares. Ito and Lee (2007) also show codesharing to be associated with lower fares.

This paper analyzes potential market effects of the Delta/Northwest merger with a particular focus on comparing predicted price changes across different product types (codeshare vs. pure online). To the best of our knowledge, our paper is the first to examine the potential market effects across different product types of an airline merger between codeshare alliance partners.

The data reveal that Delta and Northwest products are substitutable (competing) in a significant number of markets in which they offer products. Delta offers products in over half of the markets in which Northwest offers products, and Northwest offers products in almost half of the markets in which Delta offers products. Thus, antitrust authorities clearly should not grant approval of the merger on the grounds that these carriers rarely compete. Deeper analysis is required to assess the extent to which: (1) these two carriers constrain each other's pricing decisions when they compete; (2) other competing carriers would constrain the joint pricing behavior of Delta and Northwest. To get at these issues we use our econometric model to predict the extent to which Delta and Northwest's product prices will increase if these products are jointly priced in the worst case scenario where the merger is not associated with cost efficiency gains.

In our sample, Delta and Northwest have a combined 28.95% passenger share in the U.S. domestic industry, varying between 0.58% to 100% in different markets. Based on our econometric estimates, the average predicted change in price due to the merger is only an increase of 0.54%, hardly big enough to concern consumers, let alone antitrust authorities. The mean predicted price increase among Delta/Northwest products is 1.45% – however, the maximum predicted increase in price was over 13%.

To better understand predicted percent price increases for Delta and Northwest products (which varied across markets and product types), we ran auxiliary regressions with predicted percent price increases as the dependent variable and various product and market characteristics as regressors. The results reveal a significant positive relationship between the share of Delta/Northwest passengers in a market and the predicted increase in prices attributed to the merger. We also find that Delta/Northwest codeshare products have higher predicted price increases relative to their pure online products.

Finally, we analyzed competition at the market level (rather than product level) to examine market level factors that influence the predicted price increases. We find that the presence of other airlines offering competing products is crucial in keeping the predicted price increases of Delta/Northwest products low.

The rest of the paper is as follows: Section 2 outlines the model while Section 3 details the estimation. Section 4 discusses the data, the results are covered in Section 5, and Section 6 offers concluding remarks.

2. The Model

Definitions

A couple of definitions are worth mentioning before illustrating the model. These definitions follow from Gayle (2007a and 2008). A *market* is defined as an origin-destination combination. Markets are directional, meaning that a trip from Los Angeles to New York is a different market than a trip from New York to Los Angeles. This allows us to consider origin city characteristics such as population and whether or not the airport is a hub for the carrier offering the air travel product for sale.

An *itinerary* contains the origin and destination of the journey, as well as all of the intermediate stops. Thus, a non-stop flight from Chicago to Seattle is a different itinerary than a passenger who flies from Chicago to Seattle with a layover in Denver. A *product* is defined as a combination of airline(s) and itinerary. Each flight has a *ticketing carrier* and an *operating carrier*. The ticketing carrier is the airline that actually sells the flight ticket to the passenger and is the 'owner' of the product. The operating carrier is the airline that owns the plane that the passenger is traveling on for the flight.

Further, we want to study the effects of a merger on codeshared products relative to pure online products. While all flights have both an operating carrier and ticketing carrier, the ticketing carrier and operating carrier could be the same or different for any flight on the itinerary. A *pure online* product has a single ticketing carrier and operating carrier for the whole itinerary and the two carriers are the same. For example, a passenger buys a single ticket from United and flies on two United planes for his itinerary. A *traditional codeshare* product has a single ticketing carrier for the trip, but multiple operating carriers, one of which is the same as the ticketing carrier. For example, a single ticket is purchased from Delta for a two-flight itinerary where one of the planes is a Delta plane and the other is a Continental plane. A *virtual codeshare* product has a single ticketing carrier and operating carrier for the itinerary, but the operating and ticketing carriers are different. For example, a single-flight itinerary is ticketed through Northwest, but the passenger flies on a Continental plane.[10]

[10] For a more detailed analysis of codesharing, see Gayle (2008), and Ito and Lee (2007).

Demand

We start out by estimating a discrete choice demand model in which a consumer chooses one product among many alternatives with the goal of utility maximization. The consumer also has the option to choose an outside alternative (driving, taking a train, or not traveling at all).

Specifically, we use a nested logit demand model. Let there be *G* groups of products and one additional group for the outside good. Products within the same group are closer substitutes than products from different groups. Groups are defined as an origin-destination-quarter combination, so all inside products in a market belong to the same group. Let product *j* be in group *g*. The utility of consumer *i* from purchasing product *j* is given by

$$u_{ij} = \delta_j + \zeta_{ig} + (1-\sigma)\varepsilon_{ij}, \qquad (1)$$

where δ_j is the mean valuation across consumers of product *j*, ζ_{ig} is a random component of utility that is common to all products in group *g*, σ measures the correlation of the consumers' utility across products belonging to the same group, and ε_{ij} is an idiosyncratic error term. If σ = 1, there is a perfect correlation of preferences for products within the same group and the products are perfect substitutes. If σ = 0, there is no correlation of preferences. As long as σ is between 0 and 1 inclusive, the model is consistent with utility maximization, and each consumer *i* chooses the product *j* that maximizes his utility.

The mean valuation δ_j depends on the price of the product (p_j), observed product characteristics (x_j), and unobserved (by researchers) product characteristics (ξ_j):

$$\delta_j = x_j\beta - \alpha p_j + \xi_j, \qquad (2)$$

where β is a vector of parameters that measures the marginal utility of respective non-price product characteristics, and α is the marginal utility of price.

The probability that a consumer chooses *j* is as follows:

$$s_j = \frac{\exp(\delta_j/(1-\sigma))}{D_g} \times \frac{D_g^{1-\sigma}}{1+\sum_{g=1}^{G} D_g^{1-\sigma}}, \tag{3}$$

where

$$D_g = \sum_{k \in G_g} \exp\left[\delta_k/(1-\sigma)\right].$$

The choice probability coincides with the market share for the product.

The demand for product *j* is obtained by:

$$d_j = M \times s_j(\mathbf{x}, \mathbf{p}, \boldsymbol{\xi}, \theta), \tag{4}$$

where *M* is a measure of the market size, which we assume to be the size of the population in the origin city, $s_j(\cdot)$ is the predicted product share function specified in equation (3), **p** and **x** are vectors of observed price and non-price product characteristics respectively, $\boldsymbol{\xi}$ is a vector of unobserved (by researchers) product characteristics, and $\theta = (\alpha, \beta, \sigma)$ is the vector of demand parameters to be estimated.

Supply

Following the general procedure described in Nevo (2000), marginal costs are recovered by using the estimated demand elasticities and assuming a model of pre-merger pricing conduct. Then, we compute the new price equilibrium by using estimated demand, pre-merger marginal costs, and assuming a model of post-merger pricing conduct. Finally, the predicted post-merger equilibrium prices are compared to actual pre-merger prices.

Each firm *f* produces a set F_f of products. Firm *f* has a variable profit of

$$\pi_f = \sum_{j \in F_f} (p_j - c_j) q_j, \tag{5}$$

where $q_j = d_j(\mathbf{p})$ in equilibrium, q_j is the quantity of tickets for product *j* sold in the market, $d_j(\mathbf{p})$ is the market demand for product *j* specified in equation (4), **p** is a $J \times 1$ vector of product prices, and c_j is the marginal cost incurred from offering product *j*.

Producer surplus is the sum of these profits across firms. Firms choose prices to maximize profit, and multiproduct firms take into account that lost sales on one product may be partly offset by increased sales on another product. A multiproduct Nash equilibrium is given by the following system of *J* first order conditions:

$$\sum_{k \in F_f} (p_k - c_k)\frac{\partial s_k}{\partial p_j} + s_j = 0 \qquad \text{for all } j = 1,\ldots,J. \tag{6}$$

In matrix notation, the first order conditions are as follows:

$$(\mathbf{p} - \mathbf{c}) \times (\Omega \,.\!*\, \Delta) + \mathbf{s} = 0\,, \tag{7}$$

where **p**, **c,** and **s** are $J \times 1$ vectors of product prices, marginal costs, and predicted product shares respectively, Ω is a $J \times J$ matrix which captures airline ownership structure of the products, .* is the operator for element-by-element matrix multiplication, and Δ is a $J \times J$ matrix of own and cross price effects ($\frac{\partial s_j}{\partial p_j}$ and $\frac{\partial s_k}{\partial p_j}$ respectively) for all products with the own-price effects on the main diagonal.

The ownership structure matrix, Ω, consists of zeroes and ones and shows which products have the same owner. For example, suppose there is a four-product market where there are three airlines, A, B, and C. Suppose A owns products 1 and 3, B owns product 2, and C owns product 4. The ownership structure would be defined as follows:

$$\Omega = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}.$$

If one airline owns all the products in a market, the ownership structure would be a $J \times J$ matrix of ones, with J being the number of products in the market.

Product markups are determined separately for each market. The markups for products in any given market are:

$$markups = \mathbf{p} - \mathbf{c} = -(\Omega .* \Delta)^{-1} \times \mathbf{s}. \quad (8)$$

The counterfactual experiment involves specifying both a pre-merger and a post-merger product ownership structure. First, marginal costs are recovered using the pre-merger product ownership structure as follows:

$$\hat{\mathbf{c}} = \mathbf{p} + (\Omega^{pre} .* \Delta)^{-1} \times \mathbf{s}, \quad (9)$$

where $\hat{\mathbf{c}}$ is the vector of estimated marginal costs for all products and Ω^{pre} is the pre-merger product ownership structure. Now, assuming a post-merger product ownership structure of Ω^{post} and using pre-merger marginal costs, we can compute post-merger equilibrium prices by searching for the new price vector $\mathbf{p}^*$ that satisfies

$$\mathbf{p}^* = \hat{\mathbf{c}} - \left[\Omega^{post} .* \Delta(\mathbf{p}^*)\right]^{-1} \times \mathbf{s}. \quad (10)$$

Having solved for post-merger equilibrium prices $\mathbf{p}^*$, we can compare $\mathbf{p}^*$ to $\mathbf{p}$ to see how the merger would affect prices.[11]

Based on the ownership matrix Ω^{pre}, Delta and Northwest separately and independently set the price of their products within a market for which each of them are the ticketing carrier.

[11] Ivaldi and Verboven (2005) provide another application of this model by studying horizontal mergers approved by the European Commission.

This is true for all their product types – pure online, traditional codeshare, and virtual codeshare. In the case of the Ω^{post} ownership matrix, these Delta/Northwest products in the market are all jointly priced by the new ticketing carrier formed by the merger of Delta and Northwest.

3. Estimation

Observed product shares are computed by $S_j = \frac{q_j}{M}$. It is well known in empirical industrial organization that the nested logit demand model results in the following estimating equation:

$$\ln(S_j) - \ln(S_0) = x_j \beta - \alpha\, p_j + \sigma \ln(S_{j/g}) + \xi_j ,$$

where S_0 is the observed share of the outside good, and $S_{j/g}$ is the observable share of product *j* in group *g*.[12] The error term ξ_j represents product characteristics such as brand quality and promotional activities observed by consumers and firms but not by researchers.[13]

Since airlines consider non-price product characteristics before setting the price, price instruments are needed because the price will be correlated with the error term (ξ_j). Error term components, such as marketing, consumer perceptions of quality, and promotions are market-specific and will most likely have an effect on the price, but are unobservable to the econometrician. For a valid set of instruments, we need variables that are associated with the price of the product, but not associated with the error term. Without using instruments, the price

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[12] The observed share of the outside option is computed by $S_0 = 1 - \sum_{g=1}^{G} S_g$, where $S_g = \sum_{j \in G_g} S_j$. The observed within group share of product *j* is computed by $S_{j/g} = \frac{S_j}{S_g}$.

[13] For further discussion of the nested logit demand model, see Berry (1994). A disadvantage of the nested logit model is that the coefficients are not amenable to straightforward interpretation. Specifically, changes in magnitude and significance of the coefficient can be interpreted, but not the numerical value itself.

coefficient estimated will be inconsistent. Further, $S_{j/g}$ is also endogenous, as non-price product characteristics in ξ_j that affect the product price may also influence the within-group share of the product.

Our instruments include the number of competitors in the market, the number of other products offered by the airline, characteristics of competing products offered by competitors, and the itinerary distance. Each of these instruments has an intuitive explanation for their inclusion. For the competitors, supply theory predicts that a product's price will be influenced by the number and closeness of competitors in the market. Next, if an airline offers multiple products in the same market, the airline will jointly set the prices for these products. When considering other products, we examine competing products with the same number of intermediate stops and similar levels of convenience. The more similarities there are between competing products, the less discrepancy we expect between prices of these products. The inclusion of itinerary distance is based on the idea that distance is correlated with marginal cost and therefore influences price.[14]

When simple Two-Stage Least Squares (2SLS) is used to estimate the demand equation, we find that the demand parameter estimates imply negative marginal cost for some products. As such, we estimate demand using constrained Generalized Methods of Moments (GMM), where the constraint is to impose non-negative marginal costs.

Constrained GMM Estimation

The constrained GMM estimation produces demand parameters that are consistent with utility maximization and static profit maximization. Our demand estimation procedure requires solving the following constrained optimization problem:

[14] See Gayle (2007a) for similar types of instruments.

$$\underset{\theta}{Min}\left[(\xi' Z)(Z' Z)^{-1}(Z' \xi)\right]$$

$$\text{such that } \min(p - markup) \geq 0, \quad \text{and} \quad 0 < \sigma < 1,$$

where Z is the matrix of the control variables and instruments. The procedure minimizes the objective function by choosing the set of parameters in θ. We use the 2SLS estimates as a starting point for the GMM minimization procedure.

4. Data

Data are gathered from the DB1B market survey, published by the U.S. Department of Transportation. This dataset is a quarterly 10% sample of all flight itineraries in the U.S. Each observation in the dataset is a flight itinerary and includes information on operating and ticketing carriers, fares, passengers, intermediate stops, total itinerary distance, origin and destination airport, and the number of airports in the origin and destination city. Data was collected for four quarters: 2007:2, 2007:3, 2007:4, and 2008:1. Only markets that appear in all four quarters and include both Delta and Northwest itineraries are used for analysis. The data are further restricted to include only itineraries in the contiguous U.S., and foreign operating carriers such as Air France and Iberia are eliminated.[15] Further, observations were dropped that listed market fares less than $100 – this helps us avoid discounted fares that may be due to passengers using frequent-flyer miles.

Collapsing the Data

Each quarter of data originally had over 5 million observations, making the data extremely large and unmanageable. Due to the airlines being very effective at using yield management, there are many identical itineraries that have different observed fares. This leads to

[15] Eliminating the foreign airlines eliminated less than 600 observations in each quarter. Eliminating markets that flew to Alaska and Hawaii eliminated approximately 360,000 observations each quarter.

the dataset containing many repeat itineraries each listed as having passengers paying different fares. To render our data more manageable, the dataset was collapsed by product – for each quarter, passengers were aggregated over a given itinerary-airline(s) combination (this created the *quantity* variable) and the average market fare was found, creating the *price* variable. In the collapsed data set, each airline(s)-itinerary-quarter combination appears only once, with its aggregated passenger quantity and average market fare.

Creation of Other Variables

From this collapsed dataset, observed product market shares S_j are created. For the purpose of properly identifying codeshare products in the data, feeder/regional operating carriers are re-coded to match their major company.[16] For example, Comair Delta Connection (OH) was recoded as Delta (DL). Airline dummies are created, as well as indicators for whether the itinerary was pure online, traditional codeshared, or virtual codeshared. Ticketing carriers that appeared less than 40 times were dropped – this eliminated about 20 smaller ticketing carriers that appeared in the dataset. The final set of ticketing carriers is presented in Table 1. A dummy variable *hub_origin* was created indicating whether the origin airport is a hub for the ticketing carrier. This hub dummy variable was multiplied by the itinerary's number of intermediate stops to obtain an interaction variable *hub_interstop*.

A measure of product convenience is created as well, and is defined as itinerary distance divided by nonstop miles, where nonstop miles is the direct flight distance between origin and destination. Thus, the most convenient itinerary for a given market would be a direct flight from

[16] We identify codeshare products as products where the ticketing and operating carriers differ. If we did not recode operating feeder carriers to have their major carrier code, then products that have the major carrier as the ticketing carrier and associated regional feeder carrier(s) as operating carrier(s) will mistakenly be counted as codeshare products since the operating and ticketing carrier codes would differ.

origin to destination. Because of how the variable is defined, the minimum value for *convenient* is equal to 1.[17]

Table 1	
Airlines represented in the dataset	
Code	Airline
AA	American Airlines
AS	Alaskan Airlines
B6	JetBlue Airways
CO	Continental Airlines
DL	Delta Airlines
F9	Frontier Airlines
FL	Airtran Airways
G4	Allegiant Air
HP	America West
NK	Spirit Airlines
NW	Northwest Airlines
SY	Skippers Aviation
TZ	ATA Airlines
U5	International Business Air
UA	United Airlines
US	US Airways
WN	Southwest Airlines
YX	Midwest Airlines

For our purposes, each itinerary needs to have an 'owner', so itineraries that were listed as having multiple ticketing carriers were discarded from the sample. After each product is listed as having a single owner, product types are created and are denoted as *pure online*, *traditional codeshare*, and *virtual codeshare*. After the product types were defined, there were approximately 2,000 observations that didn't fit any of the three categories and these observations were dropped from the sample.

Quarter dummies are added to the dataset as well. Thus, observed product characteristics (x_j) include the following variables: origin and destination multiple airport indicators, convenience, number of intermediate stops (*interstop*), hub origin indicator, the interaction term

[17] A few corrections were needed in the dataset where itinerary distance was listed as less than nonstop miles, but the difference was only 1 or 2 miles. The problem was corrected by setting itinerary distance equal to nonstop miles when the itinerary distance was less than nonstop miles.

of hub origin multiplied by intermediate stops, codeshare type, quarter, and airline indicator. Last, the aforementioned instruments are created.

After cleaning and collapsing the data, the combined four quarters contain 569,132 observations across 34,232 markets. For estimation, a subsample of markets was randomly drawn from the full sample using a random number generator. This was necessary due to the immense size of the dataset which would overwhelm the numerical estimation procedure used by GMM. The random sub-sample contains 20,893 observations across 1,314 markets.

In order to assess the degree of substitutability across Delta and Northwest products, we analyzed the original dataset before performing any of the data cleaning described above. For each quarter, we examine the number of markets and the presence of Delta/Northwest in the markets. Table 2 shows the results.

We can clearly see that Delta offers products in over half of the markets in which Northwest offers products, and Northwest offers products in almost half of the markets in which Delta offers products. This implies Delta and Northwest products are substitutes for each other in almost half of the markets where either firm offers products. Summary statistics of the samples used for estimation are presented in Table 3.

Table 2

Dual Presence of Delta and Northwest in Markets

	Markets			
Quarter	Total	With DL	With NW	With Both
2007:2	56514	28131	22766	12549
2007:3	57314	28810	22329	12425
2007:4	56024	27566	22416	12293
2008:1	53228	25994	21591	11840

Table 3								
Summary Statistics								
	Full				Sub-sample			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Origin airport indicator	1.170147	1.839303	0	9	1.051261	1.762243	0	9
Dest. airport indicator	1.164001	1.846692	0	9	1.159384	1.901802	0	9
Origin city population	959801.6	2100230	6336	1.92E+07	900963.2	1836593	6336	1.92E+07
hub_origin	0.1582181	0.3649457	0	1	0.150242	0.3573167	0	1
Itinerary distance	1710.281	756.7978	166	5626	1698.856	767.6199	229	4826
Nonstop miles	1389.904	644.2611	166	2783	1378.261	653.659	217	2717
Intermediate stops	1.310037	0.6689009	0	3	1.312114	0.6637298	0	3
Quantity	34.60516	220.8334	1	9383	30.8812	188.8066	1	5762
Price	281.5015	167.4489	100	7851.52	280.2324	159.6504	100	2643.02
Convenient	1.278088	0.316459	1	3.861111	1.282018	0.318598	1	3.415323
Traditional codeshare	0.1118528	0.3151855	0	1	0.118652	0.3233865	0	1
Pure online	0.8385454	0.3679501	0	1	0.833246	0.3727654	0	1
Virtual codeshare	0.0496018	0.2171211	0	1	0.048102	0.2139874	0	1
Sj_g	0.0601477	0.1275238	0.0000547	1	0.062892	0.1291879	0.000116	0.9827586
S0	0.9965959	0.006382	0.8667648	0.9999998	0.996692	0.0069563	0.870265	0.9999992
ln(Sj_g)	-4.825641	2.270964	-9.814438	0	-4.716562	2.245679	-9.063463	-0.017392
ln(Sj) – ln(S0)	-11.53766	1.98149	-16.76821	-1.981727	-11.52539	1.953844	-16.76821	-1.981727
Spring	0.2593669	0.4382876	0	1	0.236395	0.4248777	0	1
Summer	0.2571108	0.4370414	0	1	0.235151	0.424103	0	1
Autumn	0.2515146	0.433884	0	1	0.269564	0.4437439	0	1
Winter	0.2320077	0.4221142	0	1	0.258891	0.4380359	0	1
Sample Size	569,132				20,893			

5. Results

Table 4 describes features of 11 of the 23 models we estimate. However, we only report results for 5 of these models (models 4, 5, 9, 10, and 11). Eight models not listed in Table 4 involved a different nesting structure, in which the data were nested by both market and airline. Most of these models gave a positive (but insignificant) coefficient on the price variable, and were thrown out. Also, four versions of a standard logit model were estimated on the full sample, but for space purposes, are not presented here. The results are available upon request.

Table 4				
List of regressions				
Model Number	**Sample**	**Estimation Technique**	**Hub x Interstop**	**Airline Dummies**
1	Full	2SLS	No	No
2	Full	2SLS	No	Yes
3	Full	2SLS	Yes	No
4	Full	2SLS	Yes	Yes
5	Full	OLS	Yes	Yes
6	Reduced	2SLS	No	No
7	Reduced	2SLS	No	Yes
8	Reduced	2SLS	Yes	No
9	Reduced	OLS	Yes	Yes
10	Reduced	2SLS	Yes	Yes
11	Reduced	GMM	Yes	Yes

For both the full sample and reduced sample, a nested logit was estimated with different inclusions and exclusions of the *hub_interstop* variable and the airline dummies. These models are estimated using 2SLS detailed below. The other model is the full specification on the subsample using GMM estimation. An OLS model including airline dummies and the *hub_interstop* variable is also estimated for comparison purposes. The full sample results of the regressions are shown in Table 5, and the results of the subsample regressions including the constrained GMM are shown in Table 6.

Variable signs and significance

To test the validity of the instruments, we regressed both endogenous variables against the instruments using OLS and also performed a Hausman test. The results show that each instrument is strongly correlated with the endogenous variables. These results are shown in Appendix A. Hausman tests in Tables 5 and 6 also reject the exogeneity of *price* and $\ln(S_{j/g})$, implying that instruments are needed.[18]

[18] The Hausman test presents a null hypothesis of *price* and $\ln(S_{j/g})$ being exogenous. The Durbin-Wu-Hausman chi-square test with two degrees of freedom rejects the null hypothesis with over 99.99% confidence.

Table 5				
Regression Results from the Full Sample				
	OLS		2SLS	
Variable				
price	-0.000337**	(0.0000106)	-0.003633**	(6.37E-05)
$\ln(S_{j/g})$	0.5638265**	(0.0009369)	0.2346224**	(0.001865)
origin_apt	-0.016191**	(0.0009283)	-0.063835**	(0.001123)
dest_apt	0.1384643**	(0.0009252)	0.0867591**	(0.001129)
convenient	-0.411686**	(0.0056451)	-0.567484**	(0.008092)
interstop	-0.415735**	(0.003287)	-0.655274**	(0.005567)
hub_origin	0.2285709**	(0.0104666)	0.3411788**	(0.012931)
hub_interstop	-0.2098**	(0.0063686)	-0.417027**	(0.007655)
virtual codeshare	-0.361678**	(0.0080486)	-0.872166**	(0.009719)
traditional codeshare	-0.415568**	(0.0054974)	-0.704275**	(0.006565)
spring	0.1070519**	(0.0047444)	0.0732034**	(0.005546)
summer	0.0859185**	(0.0047508)	0.0634193**	(0.005552)
autumn	0.0578049**	(0.0047718)	-0.001777**	(0.005628)
constant	-7.747866**	(0.0212766)	-7.895797**	(0.0252827)
R-squared	0.6023			
Wu-Hausman F test:	3.68e+04	F(2,569099)		
Durbin-Wu-Hausman chi-sq test	6.51e+04	Chi-sq(2)		

The regressions include a full set of airline dummies even though the coefficients are not reported.

Standard errors are shown in parentheses

* Statistically significant at the 5% level

** Statistically significant at the 1% level

As expected, the coefficient on *price* is negative, implying that higher prices are associated with lower levels of utility, ceteris paribus. Note that the magnitude of the coefficient is much greater in the 2SLS and GMM regressions compared to OLS. Without the use of instruments, OLS gives an underestimate of passengers' disutility to higher prices. While there is not a significant difference in the price coefficient between the full sample and sub-sample with the 2SLS models, the GMM model estimates the price coefficient to be twice as large. The larger coefficient implies an even greater underestimation of consumer price sensitivity with OLS. Clearly, instruments for price are needed, and constraining the model to allow only positive marginal costs has a large effect on the price coefficient as well.

Table 6						
Regression Results from the sub-sample						
	OLS		2SLS		GMM	
Variable						
price	-0.000474**	(5.87E-05)	-0.004964**	(0.000364)	-0.009558**	(0.000004)
$\ln(S_{j/g})$	0.530736**	(0.004926)	0.1996795**	(0.009726)	0.1789636**	(0.000090)
origin_apt	-0.049142**	(0.005078)	-0.095204**	(0.006428)	-0.082037**	(0.000056)
dest_apt_	0.1326589**	(0.00472)	0.0998923**	(0.006044)	0.1181392**	(0.000052)
convenient	-0.414639**	(0.029367)	-0.512231**	(0.043772)	-0.213207**	(0.000459)
interstop	-0.454673**	(0.017387)	-0.610826**	(0.031796)	-0.331977**	(0.000347)
hub_origin	0.2991209**	(0.055703)	0.5422949**	(0.073298)	0.8980878**	(0.000787)
hub_interstop	-0.251758**	(0.033782)	-0.506174**	(0.043058)	-0.662282**	(0.000491)
virtual codeshare	-0.417632**	(0.042967)	-0.952732**	(0.054174)	-0.921211**	(0.000436)
traditional codeshare	-0.413298**	(0.028208)	-0.735951**	(0.035258)	-0.735749**	(0.000307)
spring	-0.081641**	(0.024821)	-0.006251	(0.030326)	-0.00044**	(0.000267)
summer	0.0246055	(0.024815)	0.0185663	(0.030295)	-0.000574**	(0.000265)
autumn	0.19701**	(0.024132)	0.1167447**	(0.029735)	0.061694**	(0.000259)
constant	-7.749492**	(0.119108)	-7.836665**	(0.147083)	-7.413194**	(0.001283)
R-squared	0.5885					
Wu-Hausman F test:	1.61e+03	F(2,20860)				
Durbin-Wu-Hausman chi-sq test	2.80e+03	Chi-sq(2)				

The regressions include a full set of airline dummies even though the coefficients are not reported.

Standard errors are shown in parentheses

* Statistically significant at the 5% level

** Statistically significant at the 1% level

The coefficient on *interstop* is negative and significant in all regressions, as expected. Passengers prefer direct flights from origin to destination – more intermediate stops during the itinerary lead to lower levels of utility. The coefficient is half the magnitude in the GMM model compared to the 2SLS regressions.

The *convenient* coefficient also had the expected negative sign for all regressions, and is significant in each case. Recall that this variable is defined as itinerary miles flown divided by nonstop miles, and would thus have a higher value for flights that are more “out of the way”. Thus, the negative coefficient suggests intuitively that passengers prefer the most direct route to the destination. While the sign is the same across all specifications, the magnitude is much smaller in the GMM model.

In all regressions where the interaction term *hub_interstop* is not included, the coefficient on *hub_origin* is negative, which was not the expected sign.[19] However, the coefficient on *hub_origin* turns positive (and significant) when the interaction term is added to the regression, and the interaction term itself has a significantly negative coefficient. For a given market, a hub airline and a non-hub airline could offer a product with the same number of intermediate stops. The positive sign on *hub_origin* indicates a preference toward the hub product in this case. However, if the hub product has a sufficiently larger number of intermediate stops compared to the non-hub product, then the negative sign on *hub_interstop* suggests that the non-hub product may be chosen over the hub product.

The negative coefficient on the origin airport indicator variable suggests that any given product becomes more substitutable as the number of airports in the city increases. This is due to increased levels of competition – a greater variety of products may draw customers away from any given product.

The positive coefficient on the destination airport indicator illustrates higher demand for itineraries with a destination city containing multiple airports. This may just be reflecting unobserved factors – a larger city with more airports is more likely to also have increased tourist or business activities, which would make airline travel to this destination more desirable.

The *traditional* variable has a negative and significant coefficient – note that the "left out" product type category is pure online, so this indicates that a traditional codeshare product has a lower demand relative to a pure online product. While there are multiple operating carriers on this type of itinerary, the double markup may be eliminated because of a single ticketing

[19] These regressions are not presented here.

carrier. Thus, the negative sign may be capturing some other unobserved handiness effects. The flight itinerary for a pure online product is very streamlined, and a company can better organize its own planes and schedules to minimize layover time, and efficiently organize gates at airports. With a traditional codeshare flight, a passenger may be more likely to experience longer layovers or longer journeys through the airport to find a different gate. Even though codeshare partners try to coordinate their efforts in this manner, the negative coefficient on traditional codeshare suggests that these coordination efforts are not perfect.

The coefficient on *virtual* is negative and significant in all regressions. Moreover, it is greater in magnitude than the coefficient on *traditional* with the exception of the full sample OLS. As previously noted in Ito and Lee (2007), this negative coefficient could be due to the fact that virtual codeshare itineraries are a relatively inferior product – frequent flyer miles may often not be used, and first-class upgrades are usually unavailable on this type of itinerary.

The significance of the season dummies (and sign in one case) depends on the model specification. The *summer* dummy is always positive, and is significant in the full sample regressions. The *autumn* dummy is positive and significant in all regressions. Summer travel may be desirable for vacations, and autumn travel (which includes October – December) may be desirable to visit family and friends over the holidays.

The coefficient on $\ln(S_{j/g})$ is our estimate for σ. Note that this term only appears in the nested logit specifications of the model, as the standard logit model does not use any nesting methods to group products. The estimate for σ was as high as 0.564 in specification 5, and as low as 0.179 in specification 11. The large variation in estimates once again illustrates the importance of using instruments for endogenous variables. All estimates of σ are between 0 and 1 with significance, so the model is consistent with utility maximization.

Inference from Demand Elasticities

To get a sense of the substitutability between competing airlines' products, it is worthwhile to examine demand elasticities of the products. For comparison, we have selected eight markets to study that differ by origin-destination distance and number of competing firms. We compute a matrix of product elasticities for each market, where the main diagonal elements are own-price elasticities, and the off-diagonal elements are cross-price elasticities. For each market, the matrix will be of dimension $(J+1)\times J$, where J is the number of products in the relevant market. The extra row in the matrix contains elasticity estimates for the outside good, which includes transportation options that are not explicitly included in the model, such as purchasing an airline product with multiple ticketing carriers, choosing non-airline transportation, or not traveling at all.

However, we are most interested in competition at the firm/airline level rather than the product level, so these product elasticities have been averaged according to product ownership by airlines. Thus, for the elasticity matrices we present in Tables 7 and 8, an element is interpreted as the average percent by which the row airline's demand changes as the result of a 1 percent increase in the column airline's product price.

As expected, the own price elasticities are negative and all of the cross-price elasticities are positive, suggesting the airlines' products are gross substitutes. Further, recall that for our nested logit model, each market is defined as a nest. Thus, we see that the cross-price elasticities are identical throughout any column in the matrix.

Consider the elasticities of the Boston-Los Angeles market, shown in Table 7. When Delta raises its prices by 1%, the demand for Delta products in this market will decrease by

3.57%, and the demand for all other inside products[20] will increase by 0.0047%. When Northwest raises its prices by 1%, the demand for Northwest products in this market will fall by 4.43%, and the demand for other inside products will increase by 0.00210%. The cross-price elasticity of the outside good ranges from 0.00001% for Alaska Airlines, to 0.00009% for Midwest Express.[21] In the Buffalo-Columbus market, shown in Table 8, the outside good has estimated demand increases ranging from 0.00004% to 0.00014%. The higher elasticities of the outside good for the Buffalo-Columbus market may be largely due to the shorter distance between origin and destination, which implies that transportation alternatives such as driving are more practical substitutes for air travel.

While demand elasticities are useful and easy to interpret, they do not give us a full picture of the nature of the competition between the products within the market. To get a better idea of competition, we pay particular attention to the fact that sales will decrease for a good that experiences a price increase. Following Gayle (2007a), we want to see how those lost sales are captured by competing products. To infer information about the transfer of lost sales in the event of a price increase, we weight the elasticities by their respective quantities and divide the weighted cross-price elasticity by its quantity weighted own-price elasticity. The resulting ratio tells us the proportion of lost sales that are captured by a competitor or the outside good.

[20] We refer to products that are included in the model as "inside" products.

[21] To understand why the outside good elasticities are relatively small, we must consider that product shares are determined by the population of the origin city. Therefore, the share (outside good share) of the population that did not choose airline products that are included in our model is relatively large compared to shares for inside products. This implies that if similar amounts of people switch to the outside good as do to the inside goods, the percent change in the share of the outside good will be smaller than the percent change in the shares of inside goods.

Table 7
Price Elasticity of Demand Matrix (%)
Boston – Los Angeles, Nonstop flight miles = 2,611

	DL	NW	CO	AA	AS	FL	UA	US	YX
DL	-3.57287	0.00210	0.00183	0.00208	0.00158	0.00680	0.00239	0.00340	0.01002
NW	0.00470	-4.43044	0.00183	0.00208	0.00158	0.00680	0.00239	0.00340	0.01002
CO	0.00470	0.00210	-4.67455	0.00208	0.00158	0.00680	0.00239	0.00340	0.01002
AA	0.00470	0.00210	0.00183	-4.50683	0.00158	0.00680	0.00239	0.00340	0.01002
AS	0.00470	0.00210	0.00183	0.00208	-4.22108	0.00680	0.00239	0.00340	0.01002
FL	0.00470	0.00210	0.00183	0.00208	0.00158	-2.35082	0.00239	0.00340	0.01002
UA	0.00470	0.00210	0.00183	0.00208	0.00158	0.00680	-4.50823	0.00340	0.01002
US	0.00470	0.00210	0.00183	0.00208	0.00158	0.00680	0.00239	-4.94763	0.01002
YX	0.00470	0.00210	0.00183	0.00208	0.00158	0.00680	0.00239	0.00340	-2.08213
Outside	0.00004	0.00002	0.00002	0.00002	0.00001	0.00006	0.00002	0.00003	0.00009

Table 8
Price Elasticity of Demand Matrix (%)
Buffalo – Columbus, Nonstop flight miles = 296

	DL	NW	CO	UA	US	WN
DL	-1.46916	0.01510	0.03136	0.03317	0.03972	0.02965
NW	0.05719	-2.84334	0.03136	0.03317	0.03972	0.02965
CO	0.05719	0.01510	-1.97904	0.03317	0.03972	0.02965
UA	0.05719	0.01510	0.03136	-1.92702	0.03972	0.02965
US	0.05719	0.01510	0.03136	0.03317	-1.53040	0.02965
WN	0.05719	0.01510	0.03136	0.03317	0.03972	-1.54782
Outside	0.00014	0.00004	0.00007	0.00008	0.00009	0.00007

For example, consider three competitors, A, B, and C. Suppose the elasticities are defined as $\eta_{AA} = \frac{\partial Q_A}{\partial P_A}\frac{P_A}{Q_A}$, $\eta_{BA} = \frac{\partial Q_A}{\partial P_B}\frac{P_B}{Q_A}$ and $\eta_{CA} = \frac{\partial Q_A}{\partial P_C}\frac{P_C}{Q_A}$. The proportion of lost sales captured by firm B in the event of a price increase of firm A's product is given by $\frac{Q_B \times \eta_{BA}}{Q_A \times \eta_{AA}}$, while the proportion of firm A's lost sales captured by firm C is $\frac{Q_C \times \eta_{CA}}{Q_A \times \eta_{AA}}$. If $\frac{Q_B \times \eta_{BA}}{Q_A \times \eta_{AA}} > \frac{Q_C \times \eta_{CA}}{Q_A \times \eta_{AA}}$, we can conclude that airline B is a closer competitor to airline A than airline C is to airline A.

Table 9 presents the lost sales decomposition for the Boston to Los Angeles market. Note that the columns in the lost sales tables will add up to 100%, showing that all the lost sales are accounted for. Due to the multiplicity of products offered by Delta and United respectively in this market, these two airlines are able to recapture 6.06% and 4.69% of lost sales that result from a price increase of any one of their products. Delta captures approximately 6.2% of lost sales caused by price increases of any other firm, while United captures about 4.8% of those lost sales. Competitors who offer fewer products capture much less of the price-increasing firm's lost sales. The outside good captures around 82% of lost sales in the event of any price increase. Once again, this could mean the passenger takes an alternate transportation to the products included in our model, or chooses not to travel at all. This is not to be construed as saying that 82% of passengers choose not to travel at all in the event of a price increase.

Table 9
Lost Sales Obtained by Competing Products (%)
Boston – Los Angeles, Nonstop flight miles = 2,611

	DL	NW	CO	AA	AS	FL	UA	US	YX
DL	6.06	6.23	6.23	6.23	6.23	6.24	6.23	6.23	6.26
NW	0.44	0.37	0.44	0.44	0.44	0.44	0.44	0.44	0.44
CO	0.13	0.13	0.09	0.13	0.13	0.13	0.13	0.13	0.13
AA	2.21	2.21	2.21	2.14	2.21	2.21	2.21	2.21	2.22
AS	0.08	0.08	0.08	0.08	0.04	0.08	0.08	0.08	0.08
FL	0.59	0.58	0.58	0.58	0.58	0.29	0.58	0.58	0.59
UA	4.78	4.78	4.78	4.78	4.78	4.79	4.69	4.78	4.80
US	2.15	2.15	2.15	2.15	2.15	2.16	2.15	2.04	2.16
YX	1.46	1.46	1.46	1.46	1.46	1.47	1.46	1.46	0.98
Outside	82.09	82.00	81.98	82.00	81.98	82.19	82.02	82.04	82.35
Sum	100	100	100	100	100	100	100	100	100

In light of the main objective of our paper, it is important to note that Table 9 suggests that Delta's closest competitors in the Boston to Los Angeles market are United Airlines, American Airlines, and US Airways rather than Northwest Airlines. Northwest is only able to capture 0.44% of Delta's lost sales, while United, American, and US Airways are able to capture

4.78%, 2.21%, and 2.15% respectively. However, Delta is Northwest's closest competitor followed by United, American, and US Airways respectively. This information is useful since the weaker the pre-merger degree of competitiveness between firms that subsequently merger, the smaller is the price increase that will result from the merger, ceteris paribus.

The lost sales matrix for the Buffalo – Columbus market, a competitive shorter-distance market, is displayed in Table 10. The X entries along the diagonal mean that a firm only offers one product in the market and cannot recapture lost sales through other products. In this particular market, US Airways appears to be the dominant firm, capturing approximately 5.5% to 5.6% of other competitors' sales in the event of a price increase. Delta and United each capture approximately 3.8% of competitors' lost sales. It is also important to note that Delta and Northwest seem not to be strong competitors for each other in the Buffalo – Columbus market.

In the Buffalo – Columbus market, the outside good captures a slightly larger portion of lost sales compared to the long-distance Boston – Los Angeles market. This is largely due to alternative transportation being more viable for short distances. However, in both cases, the portion of lost sales captured by the outside good is relatively high (over 80%).[22]

Table 10

Lost Sales Obtained by Competing Products (%)

Buffalo – Columbus, Nonstop flight miles = 296

	DL	NW	CO	UA	US	WN
DL	X	3.77	3.81	3.82	3.85	3.82
NW	1.73	1.11	1.69	1.69	1.71	1.69
CO	1.62	1.57	X	1.59	1.60	1.59
UA	3.82	3.70	3.74	1.87	3.78	3.75
US	5.62	5.44	5.49	5.51	2.77	5.51
WN	1.95	1.89	1.91	1.91	1.93	X
Outside	85.26	82.52	83.36	83.61	84.35	83.63
Sum	100	100	100	100	100	100

[22] Gayle (2007a) found estimates of the outside good capturing larger amounts of lost sales, often more than 95%. In his paper, traditional codeshare products are considered to be part of the outside good. Since our model includes traditional codeshare products as part of the inside good, our outside good encompasses a smaller number of alternatives, and it is clear to see why the outside good in our paper will capture a smaller amount of lost sales caused by a price increase of any given airline product.

The tables describing elasticities and lost sales for six other markets are shown in Appendix B. In general, we find that Delta and Northwest are not always the strongest competitors for each other, but even when they are, the outside good seems to be a sufficiently attractive alternative to constrain the joint pricing behavior of the two airlines. This seems to be especially true for shorter-distance markets.

Merger Analysis

Since our main objective is to analyze the merger, recall that our dataset includes only markets that contain both Delta and Northwest products before the merger.[23] This will allow us to isolate the merger effects in markets where the two firms' services overlap. Summary statistics for variables of interest in the subsample are displayed in Table 11. The average pre-merger markup is approximately $89.78. The average predicted change in price is only an increase of 0.54%, hardly big enough to concern consumers, let alone antitrust authorities. However, the maximum predicted increase in price is over 13%.

Table 11

Summary statistics of merger analysis

Variable	Mean	Std. Dev.	Min	Max
Pre-merger marginal costs	190.4556	159.75	5.02E-07	2556.969
Pre-merger markup	89.7768	2.918	85.90399	104.5631
Post-merger predicted price	281.4915	159.66	100.0047	2643.021
Predicted Price Increases (percent)	0.543886	1.0818	0	13.0983
Delta/Northwest pre-merger combined market passenger share	35.75316	27.34	0.578927	100

To get a more detailed analysis of Delta/Northwest dominance in different markets, we calculated the combined passenger share that Delta and Northwest had in each market. For example, if 1,000 passengers flew from Minneapolis to Atlanta and 400 of them flew on Delta or Northwest tickets, then the Delta/Northwest share for this market is 40%. Note that this share is

[23] Markets that include neither firm or just one of the two firms will not experience a price increase according to our model since the ownership structure of products will be the same before and after the merger.

calculated by passengers, and not by the number of flights. This is displayed in the last row in Table 11. On average, Delta and Northwest own over one-third (35.75%) of the passenger share in markets where both firms competed before the merger.

Summary statistics suggest a positive relationship between pre-merger Delta/Northwest combined market passenger share and predicted price increases. As shown in Table 11, all products and markets considered, the average predicted percent increase in price is 0.54% and the average pre-merger Delta/Northwest combined passenger share in markets is 35.75%. However, for products with a predicted price increase between 1% and 3%, the average Delta/Northwest combined passenger share in the market is 48.76%, and for predicted price increases of 3% or more, the average Delta/Northwest combined passenger share in the market is 65.19%. For markets where Delta and Northwest have a 100% combined passenger share, average predicted price increase is 3.47%. While a 3.47% predicted price increase seems small for a market that would become a post-merger monopoly, we must remember that the outside good option may help keep airline prices low. Interestingly, the potential post-merger monopoly markets tended to be short-distance markets in which the outside good has a greater effect on demand for airline products. [24]

To rigorously examine the association between Delta/Northwest pre-merger combined passenger share and predicted price increases, we regress the predicted percent change in prices as a function of the Delta/Northwest combine passenger share (*quantshareDN*) as well as some other control variables. We also use the same approach to examine the association between

[24] Since our merger analysis is only considering markets where Delta and Northwest both offer products before the merger, a 100% Delta/Northwest combined share means that there was a pre-merger duopoly. After the merger, the market becomes a monopoly, thus explaining the larger predicted price increase. This occurred in 72 markets, but most markets had only small quantities of passengers. Larger quantity markets in which this occurred include nonstop service between Detroit and Cincinnati and nonstop service between Cincinnati and Nashville, both short-distance markets.

Delta/Northwest pre-merger combined passenger share and markups. The estimates are displayed in Table 12.

These results allow us to see what factors determine the predicted post-merger price increases. The regressions show that prices are predicted to increase by larger amounts the larger is Delta/Northwest combine pre-merger passenger share in a market. However, while these results are statistically significant, they are not economically significant. For instance, among all products, a 1% increase in the pre-merger share of Delta/Northwest passengers in a market would increase markups by 2 cents, and would cause prices to increase by 0.0056 percent. Considering Delta/Northwest products only, markups will increase by 6 cents, and price would increase by 0.013 percent. The negative coefficients on *convenient* and *interstop* suggest that prices are predicted to increase less for less convenient and intermediate stop(s) itineraries.

The left panel of the table also included dummy variables for all the airlines, but these estimates are not reported with the exception of the Delta and Northwest dummies for the price increase regression. It is worth noting that being a Delta or Northwest product has a much larger influence on the predicted price increase than any of the other control variables.

We next ran the same regression using just the Delta and Northwest products, and the results are shown in the right panel of Table 12. The sign and significance of all the variables remain the same, and the coefficients on the codeshare variables and the quantity share variable increase in magnitude.

Although the predicted price increases are relatively small, it is worthwhile to examine their distribution among product owners. While the mean percent price change is 1.45% for Delta/Northwest products, the entire sample had many larger price increases. 3,942 of the 20,893 products experienced price increases larger than 1%, all of which were Delta/Northwest products. Of these, 929 products had price increases greater than 3%, and 201 products had price increases greater than 5%. Figure 1 shows the distribution of predicted price increases among Delta/Northwest and other products.

Figure 1 shows that non-Delta/Northwest products' predicted price increases are smaller than 1 percent, and are in fact less than a quarter of a percent. Again, most predicted price increases are very small, but the smallest increases are limited mostly to the non-Delta/Northwest products. The largest estimated price increase for a non-Delta/Northwest product was just 0.2 percent. Products that are experiencing larger predicted price increases are exclusively Delta/Northwest products. Furthermore, in terms of pre-merger price levels, itinerary distance, and convenience, these Delta/Northwest products with relatively large predicted price increases are not significantly different from products in the entire sample.

For predicted price increases on the Delta/Northwest products, the coefficients on *traditional codeshare* and *virtual codeshare* in Table 12 are significantly positive, implying that these types of products will experience higher price increases (in terms of percentages) relative to pure online products. However, the results indicate that these two product types have lower absolute markups, although the difference is trivial. To examine this further, we regressed the pre-merger price against market and product characteristics and found negative but statistically insignificant coefficients on virtual codeshare and traditional codeshare variables. Thus, the price regression in the bottom panel of Table 12 suggests that, on average, Delta and Northwest codeshare products are priced similar to their pure online products in the pre-merger period, but the predicted price increase regression in the top right panel of Table 12 suggests that Delta and Northwest codeshare products' prices will increase by more than their prices for pure online products.

Table 12

Determinants of Predicted Price Increases, Markups, and pre-merger prices

Dependent Variable	Controls	All products		Delta / Northwest products only	
Predicted Price Increase (%)	quantshareDN	0.0056952**	(0.0002142)	0.0133379**	(0.000527)
	convenient	-0.0044314	(0.0176527)	-0.012497	(0.048102)
	interstop	-0.1038625**	(0.0087253)	-0.315971**	(0.024207)
	pop	-4.21E-09	(2.96E-09)	-1.92E-08**	(7.50E-09)
	virtual codeshare	0.1050561**	(0.0261098)	0.44055**	(0.069635)
	traditional codeshare	0.042055**	(0.0172248)	0.2077019**	(0.049333)
	Spring	-0.0521941**	(0.0154423)	-0.054598	(0.041644)
	Summer	0.0113392	(0.0154471)	0.0729217	(0.042568)
	Autumn	0.0255526	(0.0148981)	0.1130685**	(0.040644)
	Delta dummy	1.040643**	(0.0709552)		
	Northwest dummy	1.782691**	(0.0711815)		
	constant	-0.0763841	(0.0739537)	1.170305**	(0.073719)
Markup ($)	quantshareDN	0.0176736**	(0.0007373)	0.058735**	(0.001189)
	convenient	0.2275681**	(0.0607549)	0.644805**	(0.10842)
	interstop	0.1222014**	(0.0300297)	-0.051763	(0.054562)
	pop	5.16E-08**	(1.02E-08)	3.84E-08*	(1.69E-08)
	virtual codeshare	-0.414271**	(0.0898613)	-0.587884**	(0.156956)
	traditional codeshare	-0.407848**	(0.059282)	-0.588372**	(0.111194)
	Spring	0.0943103	(0.0531473)	0.569866**	(0.093863)
	Summer	-0.101437	(0.0531639)	0.331554**	(0.095946)
	Autumn	0.2161635**	(0.0512743)	0.542155**	(0.091611)
	constant	86.0993**	(0.2545241)	86.67144**	(0.16616)
Price	quantshareDN			0.75632**	(0.0658714)
	convenient			68.9288**	(5.711536)
	interstop			51.7058**	(3.141706)
	pop			2.65E-06**	(8.90E-07)
	virtual codeshare			-1.77262	(8.258221)
	traditional codeshare			-4.9836	(5.85047)
	Spring			-7.87709	(4.946259)
	Summer			-14.5201**	(5.059164)
	Autumn			-23.7921**	(4.82139)
	Itin. Distance / 1000			27.6729**	(2.765588)
	constant			53.0038**	(9.56746)

The regressions including all products contain a full set of airline dummies even though coefficients are not reported.

Standard errors are shown in parentheses

* Statistically significant at the 5% level

** Statistically significant at the 1% level

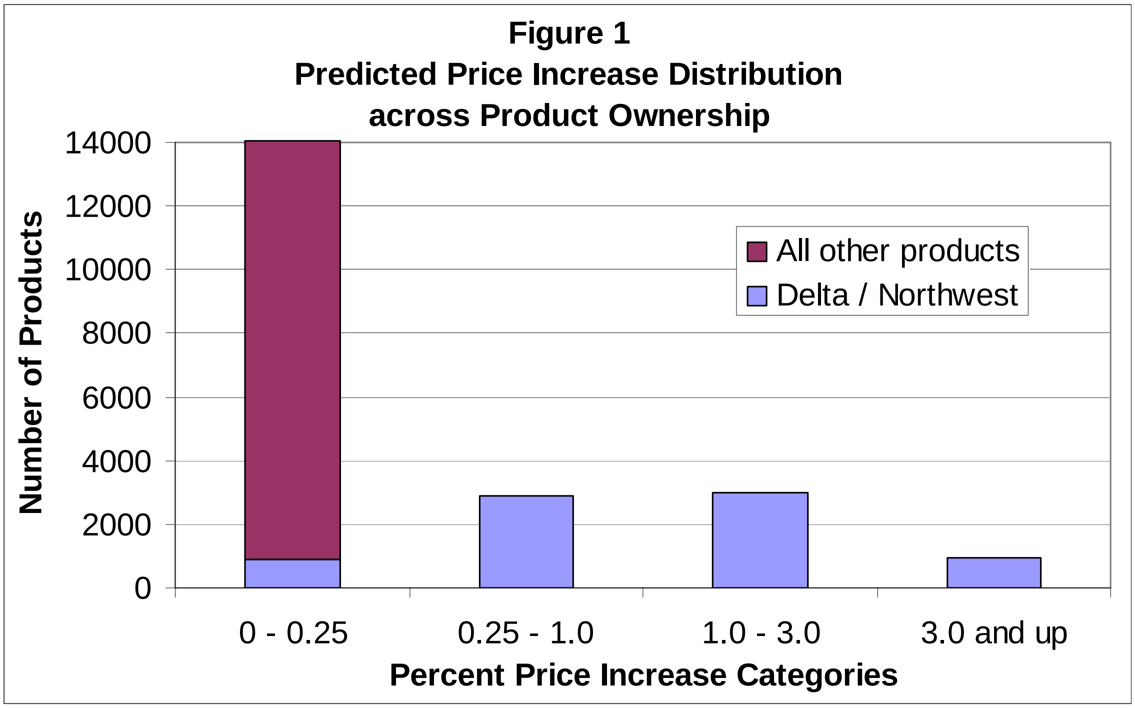


Figure 2 shows the predicted price increases among Delta/Northwest products distributed among different types of products. It is clear from Figure 2 that the number of pure online products is greater than the number of traditional codeshare and virtual codeshare products in all predicted price increase categories.

Although the regressions in Table 12 suggest that both types of codeshare products on average have higher predicted price increases compared to pure online products, in Figure 2 it appears that there is a relatively similar distribution of price increases among all types of products. To see the distribution pattern a little more clearly, we created a 100% stacked column chart in Figure 3 to show the percent of each product type in each price increase range. Figure 3 reveals that codeshare products make up a higher ratio of the highest price increases compared to the lowest price increases and conversely for pure online products.

Figure 2
Predicted Price Increase Distribution across Product Types for Delta/Northwest Products

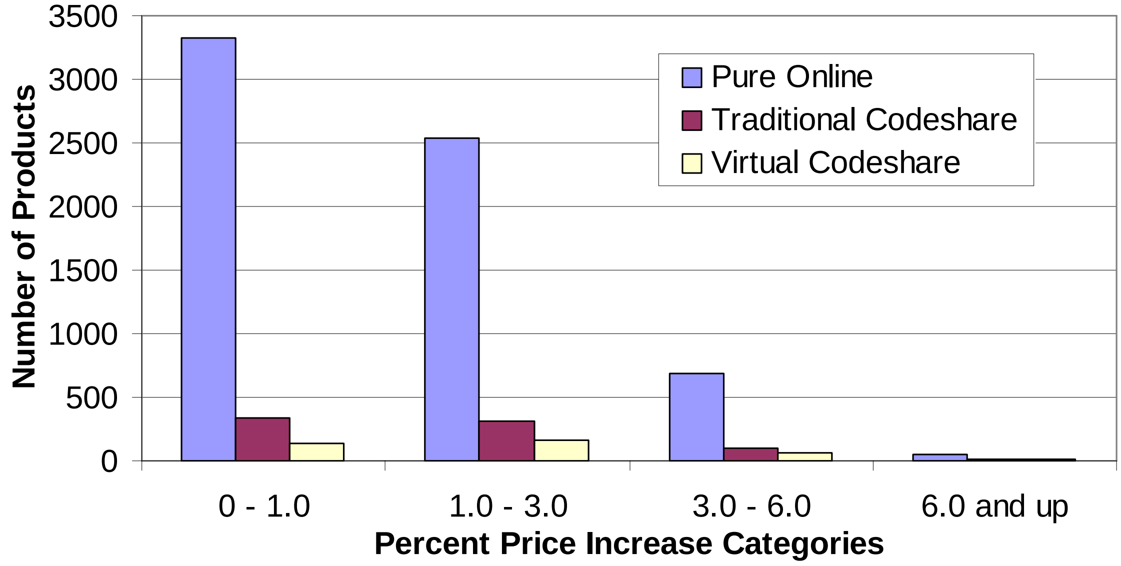
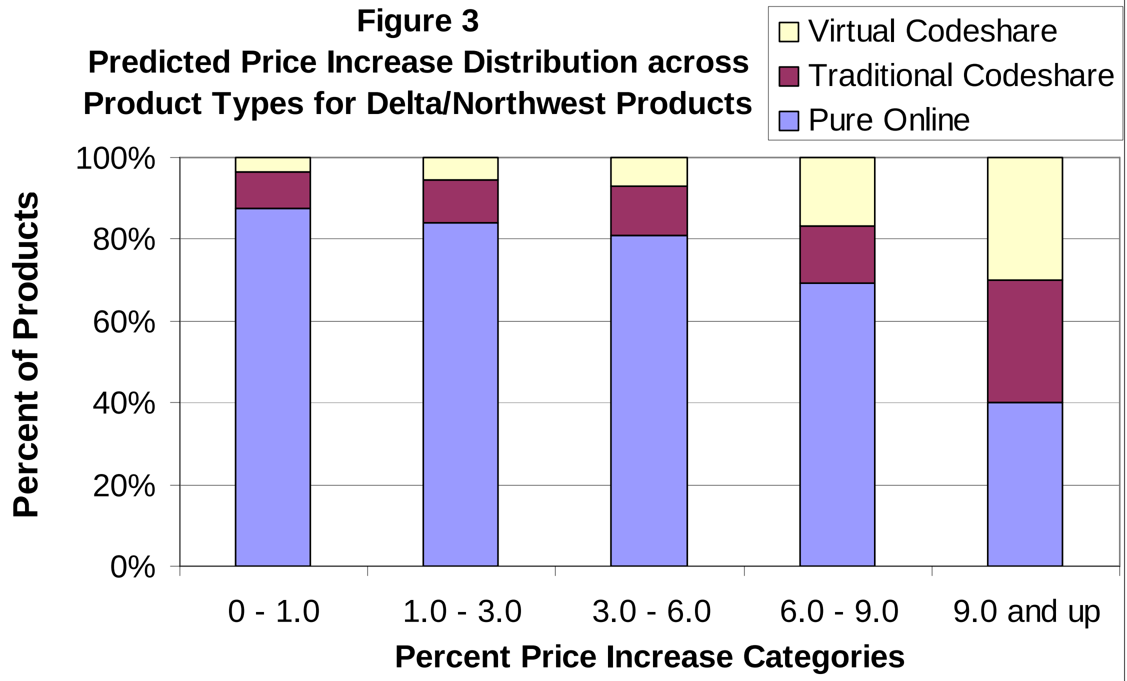


Figure 3
Predicted Price Increase Distribution across Product Types for Delta/Northwest Products



Figures 2 and 3 use only information about product types before the merger. However, products may change type classification after Delta and Northwest merge because the ownership structure of the products changes. Specifically, one of five things could happen to Delta/Northwest's products after the merger:

1. A pure online product remains a pure online product (6593 products)
2. A traditional codeshare product remains a traditional codeshare product (327 products)
3. A traditional codeshare product becomes a pure online product (444 products)
4. A virtual codeshare product remains a virtual codeshare product (73 products)
5. A virtual codeshare product becomes a pure online product (302 products)

For ease of analysis, we sort these products into 5 groups according to the number of cases above. For example, group 3 is the group of products that were of type traditional codeshare before the merger and will become pure online products after the simulated merger. One reason why product groups 2 – 5 arise is that Delta, Northwest, and Continental are codeshare alliance partners prior to the Delta/Northwest merger. As such, many of Delta and Northwest's codeshare products involve Continental as an operating carrier, and therefore these products keep their classification as codeshare products after our simulated Delta/Northwest merger. However, the codeshare products that only involve Delta and Northwest as either operating or ticketing carriers, will become pure online products with the simulated Delta/Northwest merger.

It is of particular interest to see if these five scenarios differ in terms of predicted price increases. We examine this in the left panel of Table 13, which includes only Delta/Northwest products. Using OLS, we regress the predicted price increase against a set of dummy variables that capture cases 2 – 5, as well as some previously used regressors. Note that the group dummies in Table 13 are simply a decomposition of the traditional codeshare and virtual codeshare dummies used in Table 12. On the right panel of Table 13, we change the dependent variable to pre-merger price, and add itinerary distance as an additional regressor.

We observe some interesting effects for the groups. Note that group 1 is the excluded category, which are products that were pure online before the merger. We see positive and statistically significant coefficients on the Group 3 and Group 5 dummies, indicating that pre-merger codeshare products which become pure online products after the simulated merger experience higher predicted price increases. Specifically, products that were traditional codeshare products experience an additional 0.36% predicted price increase when they become pure online products, and the virtual codeshare products have an additional 0.58% predicted price increase when they become pure online products. We see insignificant predicted price increase differences between products that stay within their codeshare type after the simulated merger (Groups 2 and 4) compared to pre-merger pure online products (Group 1).

Table 13

Determinants of Predicted Price Increases and Pre-merger Prices when Delta/Northwest Codeshare Products are Decomposed into Groups

	Dependent Variable			
Regressors	Predicted Price Increase		Pre-merger Price	
Group 2	0.0039158	(0.0730369)	11.37888	(8.67023)
Group 3	0.3609901**	(0.0634254)	-17.33308*	(7.529311)
Group 4	-0.1910077	(0.1538667)	61.2043**	(18.27282)
Group 5	0.5859146**	(0.0763692)	-16.27636†	(9.066044)
quantshareDN	0.0132348**	(0.0005267)	0.7666026**	(0.065841)
convenient	-0.0140214	(0.0479987)	69.10002**	(5.704503)
interstop	-0.327511**	(0.0242688)	52.73332**	(3.146785)
pop	-1.76E-08*	(7.49E-09)	2.50E-06**	(8.90E-07)
spring	-0.0577172	(0.0415705)	-7.553413	(4.941739)
summer	0.0654087	(0.0424962)	-13.83555**	(5.054985)
autumn	0.1082129**	(0.0405731)	-23.28909**	(4.817434)
Itin. Distance / 1000			27.9077**	(2.764374)
constant	1.194922**	(0.0736937)	50.31847**	(9.577172)

Standard errors are shown in parentheses
† Statistically significant at the 10% level
* Statistically significant at the 5% level
** Statistically significant at the 1% level

The right side of Table 13 shows a statistically significant negative coefficient on Group 3 and a marginally statistical significant negative coefficient on Group 5. These results suggest that products in Groups 3 and 5 had lower pre-merger prices relative to pure online products. This could explain why products in Groups 3 and 5 have larger predicted percent price increases.

Finally, we examine competition at the market level. To do this, dummy variables are created to indicate the presence of competitors in the market. Next, we calculated the 25th percentile, median, and 75th percentile of predicted price increases in each market so as to capture what is happening at contrasting points of the predicted price increase distribution. The predicted price increases are regressed against the Delta/Northwest combined passenger share, competitors, and market characteristics including distance and population in three separate regressions reported in Table 14. Each observation in these regressions represents a market rather than a product.

As expected, the coefficient on Delta/Northwest combined passenger share is positive, implying that Delta and Northwest product prices are predicted to increase by a greater amount when their combined pre-merger passenger share in the market is larger. The origin city population coefficient is negative and statistically significant, but the magnitude is too small to draw any useful inferences. The origin airport indicator switches signs across the three regressions, but is never significant. Interestingly, the destination airport indicator is negative, implying lower price increases for markets with a destination that includes multiple airports. This could reflect that multiple airports at the destination mean more substitute products are available to help a passenger arrive at the destination, and more substitutes implies lower price increases. The coefficients on *Nonstop Miles* are statistically insignificant.

Table 14

Percent Predicted Price Increases at Various Market Percentiles

Variable	Market Percentile 25		50		75	
DN Quantity share	0.0033843**	(0.000329)	0.004247**	(0.0004009)	0.0058518**	(0.00056)
Origin Population	-1.45E-08**	(4.01E-09)	-1.79E-08**	(4.88E-09)	-3.07E-08**	(6.82E-09)
Origin Airport Ind	-0.002577	(0.0049394)	0.0012675	(0.0060186)	0.005044	(0.008404)
Dest Airport Ind	-0.01881**	(0.0048741)	-0.016947**	(0.005939)	-0.008946	(0.008293)
Nonstop Miles	-1.46E-05	(0.0000158)	-1.65E-05	(0.0000192)	-3.02E-05	(2.68E-05)
American Airlines	-0.139769**	(0.0200172)	-0.160925**	(0.0243908)	-0.416562**	(0.034058)
Alaskan Airlines	-0.099836**	(0.0278449)	-0.140525**	(0.0339289)	-0.104442*	(0.047376)
JetBlue Airways	-0.120099**	(0.0278787)	-0.189751**	(0.03397)	-0.275585**	(0.047433)
Continental Airlines	-0.162576**	(0.0209823)	-0.225551**	(0.0255668)	-0.259872**	(0.0357)
Frontier Airlines	-0.19229**	(0.0233945)	-0.243447**	(0.0285061)	-0.391177**	(0.039804)
Airtran Airways	-0.181877**	(0.0196091)	-0.217051**	(0.0238936)	-0.427313**	(0.033363)
Allegiant Air	-0.568166**	(0.1042019)	-0.783234**	(0.1269694)	-1.397824**	(0.177291)
America West	-0.078514*	(0.0380866)	-0.11958**	(0.0464084)	-0.228961**	(0.064801)
Spirit Airlines	-0.11466	(0.0610108)	-0.138017	(0.0743413)	-0.157658	(0.103805)
Skippers Aviation	-0.398153**	(0.058477)	-0.552464**	(0.071254)	-0.788135**	(0.099494)
ATA Airlines	0.2160539**	(0.0667692)	0.2175163**	(0.0813579)	0.4975626**	(0.113603)
International Business Air	-0.319877**	(0.0951806)	-0.428963**	(0.1159771)	-0.77928**	(0.161942)
United Airlines	-0.308193**	(0.0227335)	-0.386593**	(0.0277006)	-0.651063**	(0.038679)
US Airways	-0.344432**	(0.0192305)	-0.42636**	(0.0234323)	-0.462084**	(0.032719)
Southwest	0.1067443**	(0.0209767)	0.0951628**	(0.02556)	0.1027032**	(0.03569)
Midwest	0.2376883**	(0.0245274)	0.2793229**	(0.0298865)	0.2132134**	(0.041732)
constant	1.575415**	(0.0372152)	2.035335**	(0.0453465)	3.186354**	(0.063319)

Standard errors are shown in parentheses

* Statistically significant at the 5% level

** Statistically significant at the 1% level

Most of the major airlines' presence indicator variables have a negative coefficient, as expected. The presence of other airlines offering competing products will keep the prices of Delta/Northwest products lower. However, the coefficients on Southwest and Midwest are positive. Interestingly, Southwest still has the largest mean passenger share even after combining Delta and Northwest passenger shares.[25] The positive coefficient for the presence of

[25] This can be seen using just the 2008:1 dataset, which was the most recent available data. Without using our previously mentioned data filters, Southwest had a passenger share of 20.2%, while Delta and Northwest combined had a passenger share of 19.1%. These are very close to the results presented at the May 14th, 2008 hearing (see footnote 27) which illustrated that, using 2007:3 data, Southwest had a 19.4% passenger share and Delta/Northwest had a 19.2% passenger share.

Southwest variable may be suggesting that Southwest's products are sufficiently differentiated from Delta/Northwest products, thus limiting the amount of competition between the two.

Notwithstanding the positive coefficients on Southwest and Midwest, the overall message to take away from Table 14 is that the presence of other airlines in a market matter for restraining the exercise of market power. Furthermore, this result holds at contrasting points of the predicted price increase distribution (25th, 50th, and 75th percentiles). As such, antitrust authorities may want to pay closer attention to markets that may become a monopoly or duopoly after the merger.[26]

6. Conclusions

Using a structural econometric model and pre-merger data, this paper studied the potential effects of the imminent Delta/Northwest merger. Our findings suggest that, on average, the Delta/Northwest merger will not cause significant price increases. We predict larger price increases in markets that are dominated by Delta and Northwest, and on the Delta/Northwest products themselves. However, even in markets that have a large pre-merger share of Delta/Northwest products, the outside good option has the ability to restrain extremely large price increases, particularly in short-distance markets. To prevent market power abuse in concentrated markets, the DoJ may want to carefully monitor prices and behavior in markets that have the largest combined Delta/Northwest passenger shares. Further, we find an interesting result with positive price increases associated with the presence of Southwest. Once again, the DoJ may want to monitor activity after the merger.

[26] Such potential post-merger duopoly markets include non-stop service from Atlanta to Detroit, Memphis, and Minneapolis. However, Airtran, not Southwest, is the one large competitor to Delta and Northwest in these markets during the pre-merger period. In particular, Delta and Northwest have a 76.2% combined share in the Atlanta-Minneapolis non-stop market.

Codeshare products between Delta and Northwest, both traditional and virtual, have larger predicted price increases in terms of percentages relative to their pure online products. In addition, Delta/Northwest codeshare products that become pure online products in the post-merger scenario experience higher predicted price increases than products that remain codeshared with other airlines.

This paper adds to the relatively sparse literature studying the pricing of pure online versus codeshare product types. To our knowledge, it is the only paper that examines changes in prices of different product types as the result of a merger.

Future work may involve studying international markets rather than just US markets. A major selling-point of the merger on a worldwide scale is that the only non-stop overlap market for Delta and Northwest is New York-Amsterdam. Delta and Northwest have antitrust immunity on this route to coordinate services even if the merger had failed.[27] Thus, significant international price effects are unlikely.

However, most future empirical research will only be possible with post-merger data that will not be available until at least a couple of quarters after the merger is completed. Then, instead of predicting the effects of the merger, the actual data could be analyzed to see what the true effects are. Specifically, given post-merger data, an analysis similar to Peters (2006) could be replicated with the Delta/Northwest merger.

[27] Hearing on: Impact of Consolidation on the Aviation Industry, with a Focus on the Proposed Merger between Delta Air Lines and Northwest Airlines

Appendix A

Table A

Instrument Validity Test

Variable	Price		ln(Sj_g)	
Nest_sum_convenient	1.463295**	(0.0546008)	-0.008004**	(0.000586)
Nest_sum_interstop	1.857765**	(0.0400207)	0.072533**	(0.0004295)
Nest_convenient	93.69689**	(2.098047)	-2.679663**	(0.0225185)
Nest_interstop	-56.56643**	(1.551663)	-1.014712**	(0.0166541)
N_comp	-3.988629**	(0.1054436)	-0.154685**	(0.0011317)
N_multi	-3.334339**	(0.1071853)	-0.145705**	(0.0011504)
comp_distance	-0.266418**	(0.0303568)	0.004013**	(0.0003258)
close_comp	-3.275914**	(0.0311703)	0.047139**	(0.0003346)
Itinerary distance / 1000	75.41188**	(0.3987598)	-0.679823**	(0.0042799)
constant	116.7935**	(3.541902)	2.501058**	(0.0380155)
R-squared	0.1216		0.4499	

Dependent Variable: Price; ln(Sj_g)

Standard errors are shown in parentheses

*   Statistically significant at the 5% level

** Statistically significant at the 1% level

Appendix B

Table B1

Price Elasticity of Demand Matrices (%)

Post-Merger Monopoly Markets

	Nashville – Cincinnati Nonstop Miles = 230		Detroit Metro – Cincinnati Nonstop Miles = 229		Pensacola – Sioux Falls Nonstop Miles = 1,045		Tennessee Tri-cities – San Antonio Nonstop Miles = 1,046	
	DL	NW	DL	NW	DL	NW	DL	NW
DL	-4.35788	0.11682	-4.65038	0.19437	-4.37904	0.14772	-3.22370	0.18604
NW	0.09438	-1.41943	0.10170	-3.53221	0.21137	-3.99507	0.19336	-2.63880
Outside	0.00008	0.00009	0.00005	0.00010	0.00004	0.00004	0.00007	0.00007

Table B2

Price Elasticity of Demand Matrix (%)

Dayton – Grand Rapids, Nonstop Miles = 217

	DL	NW	CO	AA	UA	YX
DL	-2.49763	0.10199	0.02012	0.08516	0.08586	0.05140
NW	0.10768	-1.86379	0.02012	0.08516	0.08586	0.05140
CO	0.10768	0.10199	-4.33055	0.08516	0.08586	0.05140
AA	0.10768	0.10199	0.02012	-2.49319	0.08586	0.05140
UA	0.10768	0.10199	0.02012	0.08516	-2.71380	0.05140
YX	0.10768	0.10199	0.02012	0.08516	0.08586	-2.87335
Outside	0.00009	0.00008	0.00002	0.00007	0.00007	0.00004

Table B3

Price Elasticity of Demand Matrix (%)

Las Vegas – Atlanta, Nonstop Miles = 1,747

	DL	NW	CO	AA	F9	FL	UA	US	HP	NK	YX
DL	-4.45943	0.00283	0.00093	0.00278	0.00345	0.00461	0.00323	0.00201	0.00214	0.13411	0.00176
NW	0.00208	-2.20189	0.00093	0.00278	0.00345	0.00461	0.00323	0.00201	0.00214	0.13411	0.00176
CO	0.00208	0.00283	-5.02315	0.00278	0.00345	0.00461	0.00323	0.00201	0.00214	0.13411	0.00176
AA	0.00208	0.00283	0.00093	-3.42165	0.00345	0.00461	0.00323	0.00201	0.00214	0.13411	0.00176
F9	0.00208	0.00283	0.00093	0.00278	-2.90501	0.00461	0.00323	0.00201	0.00214	0.13411	0.00176
FL	0.00208	0.00283	0.00093	0.00278	0.00345	-2.45981	0.00323	0.00201	0.00214	0.13411	0.00176
UA	0.00208	0.00283	0.00093	0.00278	0.00345	0.00461	-2.82749	0.00201	0.00214	0.13411	0.00176
US	0.00208	0.00283	0.00093	0.00278	0.00345	0.00461	0.00323	-2.97188	0.00214	0.13411	0.00176
HP	0.00208	0.00283	0.00093	0.00278	0.00345	0.00461	0.00323	0.00201	-2.15765	0.13411	0.00176
NK	0.00208	0.00283	0.00093	0.00278	0.00345	0.00461	0.00323	0.00201	0.00214	-1.74551	0.00176
YX	0.00208	0.00283	0.00093	0.00278	0.00345	0.00461	0.00323	0.00201	0.00214	0.13411	-3.42672
Outside	0.00002	0.00003	0.00001	0.00003	0.00004	0.00005	0.00003	0.00002	0.00002	0.00137	0.00002

Table B4
Lost Sales Obtained by Competing Products (%)
Post-Merger Monopolized Markets

	Nashville – Cincinatti Nonstop Miles = 230		Detroit Metro – Cincinnati Nonstop Miles = 229		Pensacola – Sioux Falls Nonstop Miles = 1,045		Tennessee Tri-cities – San Antonio Nonstop Miles = 1,046	
	DL	NW	DL	NW	DL	NW	DL	NW
DL	7.03	11.15	X	2.26	3.30	6.93	6.00	12.12
NW	7.88	X	16.11	10.99	11.78	5.72	6.98	X
Outside	85.09	88.85	83.89	86.75	84.93	87.34	87.02	87.88
Sum	100	100	100	100	100	100	100	100

Table B5
Lost Sales Obtained by Competing Products (%)
Dayton – Grand Rapids, Nonstop Miles = 271

	DL	NW	CO	AA	UA	YX
DL	X	4.36	4.15	4.27	4.26	4.21
NW	5.41	X	5.21	5.37	5.35	5.28
CO	0.48	0.49	X	0.48	0.48	0.47
AA	3.45	3.48	3.32	X	3.41	3.36
UA	3.20	3.23	3.08	3.17	X	3.12
YX	1.83	1.85	1.77	1.82	1.81	X
Outside	85.63	86.58	82.47	84.89	84.69	83.56
Sum	100	100	100	100	100	100

Table B6
Lost Sales Obtained by Competing Products (%)
Las Vegas – Atlanta, Nonstop Miles = 1,747

	DL	NW	CO	AA	F9	FL	UA	US	HP	NK	YX
DL	2.21	2.30	2.29	2.30	2.30	2.30	2.30	2.30	2.30	2.47	2.30
NW	0.81	0.67	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.87	0.81
CO	0.11	0.11	0.08	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
AA	0.46	0.46	0.45	0.34	0.46	0.46	0.46	0.46	0.46	0.49	0.45
F9	0.32	0.32	0.32	0.32	0.16	0.32	0.32	0.32	0.32	0.35	0.32
FL	3.24	3.24	3.23	3.24	3.24	2.99	3.24	3.24	3.24	3.48	3.24
UA	1.62	1.62	1.61	1.62	1.62	1.62	1.47	1.62	1.62	1.74	1.61
US	1.96	1.96	1.96	1.96	1.96	1.97	1.96	1.87	1.96	2.11	1.96
HP	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	X	0.11	0.10
NK	7.14	7.14	7.14	7.14	7.15	7.15	7.15	7.14	7.14	X	7.14
YX	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	X
Outside	81.99	82.03	81.94	82.01	82.05	82.12	82.04	82.00	82.00	88.21	81.96
Sum	100	100	100	100	100	100	100	100	100	100	100

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