Effect of Merger on Market Price and Product Quality: American and US Airways

Somnath Das*

December 16, 2017

Abstract

In this paper, I analyze the effect of the merger between American Airlines (AA) & US Airways (US) on market price and product quality. I use two complementary methodologies: difference in difference and merger simulation. The difference-in-differences analysis (DID) shows that the price has decreased and the decrease in price is larger in bigger city-pair markets. Slot divestiture also has been helpful in reducing the price. The DID analysis also shows that the merger has no significant effect on frequency of flights, number of seats, delay in arrival, and delay in departure. The merger has significant effect in reducing number of canceled flights in larger markets. The merger simulation estimates a discrete choice structural model of consumer demand to predict the post-merger price and compares the predicted post-merger price and pre-merger price. I find that change in ownership leads to a 3% increase in price. The structural model performs better in predicting the post-merger price if deviation from the Bertrand-Nash conduct is allowed. A 10% cost reduction due to merger is able to predict the post-merger price quite accurately.

Keywords: Merger, Efficiency, Market Power, Product Quality.

JEL Classification: L1, L4, L9

I am grateful for guidance from my advisor Professor Stephen Martin. I am thankful for comments from Purdue faculty members Ralph Siebert, Joe Mazur, Deniz Yavuz, and Mohitosh Kejriwal; Dean Showalter for his comments at the MEA meeting 2017; and Professor John E. Kwoka, Eugene Orlov, and Debi Prasad Mahapatra for their suggestions at IIOC 2017. All errors are my own.

---

*Purdue University, Krannert School of Management

1 Introduction

According to the United States Department of Justice's (DOJ) updated 2010 merger guidelines, "merger should not be permitted to create, enhance or entrench market power or to facilitate its exercise"[1]. A merger can decrease competition by reducing the number of firms in the market. In the case of the 2013 merger between American Airlines and US Airways, the DOJ along with seven states and district of Columbia decided to challenge the merger because of anti-competitive concerns. AA and US Airways argued that the merger would generate substantial efficiency in terms of cost savings and consumer network benefits. The following quote is from the chief executive officer (CEO) of US Airways defending the merger:

This merger will greatly enhance competition and provide immense benefits to the traveling public. Combined, US Airways and American Airlines will offer more and better travel options for passengers through an improved domestic and international network, something that neither carrier could provide on its own. Millions more passengers each year will fly on this new network than would fly on US Airways and American, should they be forced to remain separate. Conservative estimates place the net benefits to consumers at more than $500 million annually. Simply put, from the perspective of consumers, the new American will be much greater than the sum of its parts. This merger will be pro-competitive and lawful. Plaintiffs' request for this Court to enjoin the merger should be summarily denied.[2]

Since the US airline industry has only a few large competitors, this merger raises the issue of increasing market power for the existing airlines. But an increase in market power may not be always welfare reducing for society as a whole. Even though an increase in market power and the resulting increase in price is not desirable from the point of view of consumers' welfare, Williamson (1968) showed that there is a trade-off between efficiency gain and market power effect as in Figure 1.

[1]https://www. justice. gov/atr/horizontal-merger-guidelines-08192010#5c

[2]https://www.dallasnews.com/business/airlines/2013/09/10/heres-us-airways-defense-of-its-merger-with-american-airlines

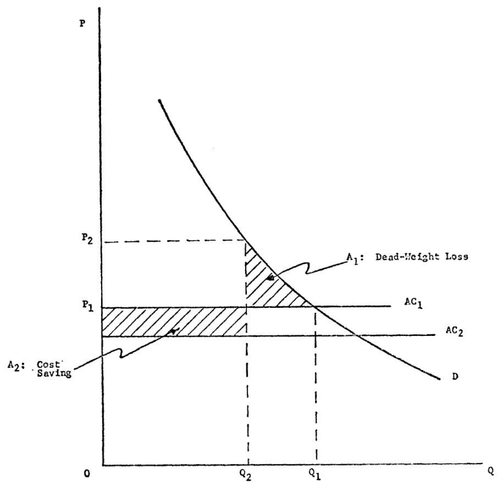


Figure 1: Cost Savings vs Market Power

According to Williamson (1968) a market power effect is necessary but not sufficient for a merger to reduce welfare. Accordingly in Figure 1 if the area of A_2 is larger than area of A_1 then the merger will be welfare-improving even though there is a increase in price. My paper is more focused on consumers' welfare reduction due to increase in price.

There is always a debate about efficiency gain and market power effects in mergers involving airlines. The efficiency gain may be generated from cost savings in airport operations, information technology, and supply chain management. Synergy is the concept that the performance of two companies combined will be greater than the sum of the performances of the separate individual companies. It can occur due to cost reductions, economies of scale, combined human resources, and technology.

The market power may be generated due to a reduction in the number of competitors in the market. Due to removal of a competitor, a firm might be able to profitably raise the market price of a good or service. While price decreases due to efficiency, it increases due to market power effect.

There is anecdotal evidence, for example, in popular media reports, that service quality goes down after a merger. Similar to price, there are two opposite effects that affect product quality: a positive effect due to a larger resource pool and negative effects due to problems in integration. Service quality can improve because of the combined resource pool of the merged airline. The new merged airline can improve quality by efficiently managing a larger resource pool. For example, if there is technical problem in the aircraft, a firm with a larger number of aircraft can deploy a substitute aircraft and reduce delays in departure. A larger airline can also internalize congestion externalities.[3] The new airline can improve quality by adopting the best practices of the two airlines.

Quality of service can decrease due to problem in integrating important resources. Problems can occur in combining the labor and merging the reservation systems of the two airlines. Reduced competition in the post-merger period may also reduce quality.

A post-merger empirical analysis can determine whether efficiency or market power dominates by analyzing the price before and after the merger. Also, change in quality of service can be analyzed from change in flight frequency and other observable data such as delays and cancellation of flights.

While there are many studies that analyze the effect of the merger on market price, there are few studies that analyze the effect on product quality. This paper analyzes the effect of the merger on product quality in addition to analyzing the effect on price. The merger between the American and U.S. Airlines is quite special in many aspects. First, these two airlines together were going to create the largest airline in the world when the merger was proposed in 2012. Second, American Airlines was undergoing bankruptcy during that time. Last, these two airlines had 30% overlapping routes among their city pair markets. It is a important merger to study because of these three unique factors. Little scholarly attention has been given to this merger.

I use two complementary methodologies: difference-in-differences analysis and merger simulation. From the difference in difference analysis I found that the merger has significant negative effect on price and the effect is larger for larger markets. The effect on price in smaller markets is opposite that in larger markets implying that smaller city-pair markets have not benefited from the merger. I also found that the merger has no significant impact on the frequency of flights, the number of seats, and delays in departure or arrival. But the merger did reduce the number of canceled flights in bigger markets. From the merger simulation I found that tacit collusion lowers the percentage cost saving required to match the simulated price with the actual post-merger price.

Section 2 of the paper briefly describes related literature. Section 3 covers the history of the U.S. airline industry. Section 4 provides a brief background of the merger. Section 5 describes the data and the variables. Section 6 outlines the identification strategy. Section 7 describes the merger simulation. Section 8 discusses the estimation. Section 9 reports the results. Finally,

[3]Congestion externalities are created when airlines do not consider that adding flights may lead to increased delays for other air carriers. See Mayer & Sinai (2003) for more details.

section 10 indicates the conclusion.

2 Literature Review

There is always a trade-off between efficiency gain and market power in the case of a merger between two firms. Williamson (1968) analyzed this trade-off and concluded that antitrust authorities should consider both sides before deciding to approve or reject a merger. If the efficiency gain dominates the market power effect then the price will decrease, otherwise, the price will increase.[4]

After the airline industry deregulation in 1978 a lot of mergers took place. Carlton et al. (1980) studied the merger between North Central Airlines and Southern Airways and did not find any significant increase in price. Borenstein (1990) analyzed two mergers: the Northwest (NW) merger with Republic Airlines (RP) and Trans World Airlines' (TWA) purchase of Ozark (OZ). The paper showed that the combined airlines gained airport dominance which resulted in substantial market power. Werden et al. (1991) examined the same two mergers above and found a considerable increase in price and a reduction in service. Morrison (1996) studied NW-RP, TWA-OZ and PI (Piedmont)-US (US Airways). He found that the price increases were 2.5% for NW-RP, 15.3% for TWA-OZ, and 23% for PI-US merger.

Kim & Singal (1993) studied airline mergers between 1985-1988 and showed that the efficiency gain on airfares was more than offset by the exercise of increased market power. Evans & Kessides (1993) found a positive correlation between route concentration and price. They also found a positive correlation between airport concentration and price.[5]

There are a few studies that have used merger simulation technique to predict the post-merger price. Peters (2006) used merger simulation to predict the post-merger prices for five mergers that took place in the 1980s and then made a comparison between predicted post-merger prices and actual post-merger prices. He concluded that deviations from the assumed model of firm conduct play an important role in understanding the observed difference between the predicted and actual post-merger prices.

Kwoka & Shumilkina (2010) analyzed the US-Air and Piedmont merger and showed that the combined firm achieved pricing power in many routes after merging with a potential competitor. Bilotkach (2011) analyzed the

[4]Farrell & Shapiro (1990) analyzed the general conditions under which horizontal mergers raise prices.

[5]Other studies that analyzed the relationship between concentration and market power includes Borenstein (1989) and Abramowitz & Brown (1993).

relationship between multi-market contact (MMC) and intensity of competition. The paper showed that high MMC (due to a merger) resulted in a reduction of the frequency of flights.

Many papers have analyzed the effect of mergers on market price (Carlton et al. (1980), Kim & Singal (1993), Focarelli & Panetta (2003)). The results from the empirical literature are mixed. While Kim & Singal (1993) found that price increased due to merger Carlton et al. (1980) did not find any significant impact on price.

In case of bank merger Sapienza (2002) found that for small target firms the lending rate decreased but for large target firms the rate increased. Prager & Hannan (1998) found that banks reduce their deposit rates after merger. Kahn et al. (2005) found that the lending rate for individual loans increased but for automobile loans the rate did not increase much.

For hospital mergers Dafny (2009), Krishnan (2001), and Capps & Dranove (2004) found that the prices after merger increased due to higher market power.

Even though there are many studies that analyze the effect of merger on price there are very few studies that look into the effect of the merger on product quality. Mazzeo (2003), Rupp & Holmes (2006), Rupp et al. (2006), and Prince & Simon (2009) found that there is a positive relationship between quality and competition. In the case of the hospital industry, Vogt & Town (2006) found mixed evidence of quality change in different mergers. Ho & Hamilton (2000) found that merger affected the quality negatively in many cases. In the case of the airline industry, Chen & Gayle (2013) measured quality as the ratio of nonstop flight distance to itinerary flight distance and found that quality improved after merger.

This paper fills the gap in the literature by disentangling the cost saving and the conduct parameter with a counterfactual simulation. I also analyze the effect of merger on product quality. Since there are very few empirical studies that analyze this aspect of product quality this paper contributes to understanding the effects on both price and product quality due to the AA-US merger.

3 US Airline Industry

Borenstein & Rose (2008) gave a very detailed overview of the U.S. passenger airline industry. The Civil Aeronautics Board (CAB) was established in 1938. It directly regulated the airline industry by controlling prices, entry, exit and merger. In 1958, Federal Aviation Administration (FAA) was created to provide for the safe and efficient use of national airspace.[6].

In the 1970s the CAB was discredited with a bad reputation for not being able to deliver a good market performance. The Airline Deregulation Act of 1978 was aimed at bringing competitiveness in the commercial aviation industry and removing government regulation without reducing the powers of Federal Aviation Administration (FAA) over all aspects of air safety. After the deregulation, prices were reduced by 30% in inflation-adjusted terms. The airline industry faced a lot of challenges during the 80s and a large number of mergers took place in the industry.

After the attack on 11th September 2001, the airline industry faced a lot of new challenges including weak demand and fuel price volatility. Both the legacy airlines and the low cost carriers (LCCs) have responded to these challenges by bankruptcies, reorganizations, spin-offs, and new pricing strategies. There have been six major mergers in recent years: US Airways and America West Airlines (2005), Delta Air Lines and Northwest Airlines (2008), Republic Airlines and Midwest Airlines (2009), Republic Airlines and Frontier Airlines (2009), United Airlines and Continental Airlines (2010), and American Airlines and US Airways(2013).

4 The AA-US Merger Background

On November 29, 2011, American Airlines filed for bankruptcy. In April 2012 US airways announced it would take over American Airlines which was in bankruptcy proceedings. In February 2013, American Airlines and US Airways announced plans to merge, creating the largest airline in the world.

On August 13, 2013, the United States Department of Justice along with attorneys general from the District of Columbia, Arizona (Headquarters of US Airways), Florida, Pennsylvania, Tennessee, Texas (headquarters of American Airlines), and Virginia filed a lawsuit to block the merger, arguing that it would result in less competition and higher prices. American Airlines and US Airways both said that they would fight the lawsuit and defend their merger.

The Department of Justice reached a settlement of its lawsuit on November 12, 2013. The settlement required the merged airline to give up landing slots or gates at 7 major airports. Under the deal, the new American was required to sell 104 slots at Ronald Reagan Washington National Airport and 34 slots at LaGuardia Airport. Additionally, AA had to sell two gates at O'Hare International Airport, Los Angeles International Airport, Logan International Airport, Dallas Love Field and Miami International Airport.

[6]https://www.faa.gov/about/history/brief_history/

Some of the slots were sold to low-cost carriers such as JetBlue and Southwest Airlines[7].

An appeal filed in the US Supreme Court against the merger complaining about price increases was declined by the Supreme Court on December 8, 2013[8]. On this day American Airlines emerged from bankruptcy as AMR Group. On April 8, 2015, the Federal Aviation Administration awarded American Airlines and US Airways a single operating certificate. Reservation systems of the two airlines were merged on October 17th, 2015.

5 Data

5.1 Data for Merger Simulation

The main source of data for this project is DB1B database of the Department of Transportation. The database is a 10% quarterly sample of airline origin and destination survey. The database has three different parts: DB1B coupon, DB1B market, and DB1B Tickets. There are some variables that are common to all of the three databases and some variables are only specific to one of them.

For the purpose of this study, I restrict the data to 48 U.S. contiguous states only. The DB1B Tickets dataset contains information about each itinerary: the sequence of airports visited including the origin and the final destination, the number of connections each way, ticket price, the number of passengers, information about the ticketing carrier and operating carrier, and distance traveled. I adjust all prices using the CPI assuming 2009 as the base[9]. I drop itineraries with fares which are unreasonably high or low (itineraries with fares above $2000 or below $50 are dropped)[10]. I also exclude round-trip itineraries with more than one connection each way. Itineraries with multiple destinations are also excluded. These are standard steps in the literature to clean and simplify the data.

For the analysis, I combine different smaller airlines owned by the same parent company. For example, American Eagle is a subsidiary of parent company American Airlines. Codeshare agreements are also treated in a

[7]https://www.justice.gov/opa/pr/justice-department-requires-us-airways-and-american-airlines-divest-facilities-seven-key

[8]http://www.frequentbusinesstraveler.com/2013/12/supreme-court-declines-to-block-american-us-air-merger/

[9]CPI link: https://www.bls.gov/cpi/data.htm

[10]Extremely low fares indicates that those tickets were purchased using frequent flier miles or some kind of promotion by the airlines. I also dropped the itineraries with "not credible" fares.

similar way. For the simplification of the analysis, I assign the ownership of the codeshare flights to the ticketing carrier who actually sells the ticket to the consumer. I drop itineraries with multiple ticketing carriers.

I define a market as a unique year-quarter-origin-destination combination. A market is defined as a directional airport-to-airport trip in a particular year and a particular quarter, for example, in 2016 quarter 1, Indianapolis (IND) to Chicago (ORD). "Directional market" implies that air travel from Indianapolis to Chicago is a distinct market from air travel from Chicago to Indianapolis. This implies also that the characteristics of the origin airport are an important factor affecting air travel demand. I define a product as a unique combination of carrier and number of connections, for example, in Table1 a non-stop flight on American Airlines from Chicago to Houston is a different product compared to flying to Houston via Dallas-Forth Worth. I drop very small markets, following the literature. Markets with less than 200 passengers in a quarter are dropped.

Table 1: Examples of Different Products

Origin	**Connection1**	**Destination**	**Carrier**	**Product**
ORD	DFW	HOU	AA	1
ORD	NON STOP	HOU	AA	2
ORD	DEN	HOU	UA	3
ORD	NON STOP	HOU	UA	4
ORD	NON STOP	HOU	NK	5

Source:DB1B

In the airline industry the price for different flights varies across different unobservable characteristics such as time of purchase, in-flight services, and leg room. Following standard procedure, see Peters (2006), I aggregate observations at the product level. I define the price of a particular product as the passenger-weighted average fare of all of its observed fares in the data and the quantity as the sum of the passengers. For calculating the market size, I estimate the inbound and outbound traffic from origin and destination airports and then calculate the market size using an idea similar to the gravity model in trade literature.

5.2 Sample Range

I define the pre-merger period as eight quarters before the merger is announced, from 2010Q2 to 2012Q2. I define the post-merger period as four quarters after the merger is completed, from 2016Q1 to 2016Q4. The selection of 2016Q1 as starting of the post-merger period is reasonable since International Air Transport Association (IATA) retired the "US" code from 2016Q1 which serves as official recognition of the completion of the merger at that time. The summary statistics of the pre-merger and the post-merger period is given in table 2 and table 3.

5.3 Overlapping Markets

I keep only those markets in which the number of tickets sold in a particular quarter is at least 2000, and all carriers sell at least 500 seats with at least 100 seats on any particular product. After that, I have in total 13925 markets in the pre-merger data. Out of the total markets, AA flies to 4552 markets while US flies to 5020 markets. The total number of overlapping markets is 1308, which is 29% of the markets served by American Airlines and 26% served by US Airlines.

5.4 Data for DID Analysis

I consider 2010Q2 to 2012Q2 as my pre-merger period and 2016Q1 to 2016Q4 as the post-merger period. The second database I use is T-100 Domestic Segments database of DOT. This data is a domestic nonstop segment data and the frequency of the data is monthly. I use this database for calculating the flight frequency in a particular market.

I use the T-100 Domestic Segments database for flight frequency. I use the number of departures from a particular airport pair market to calculate the frequency of flights. The frequency of the data is monthly so I add the monthly number of departures to calculate the quarterly frequency. I then match this data with the DB1B database. I use On Time Performance database for quality related variables such as delay and cancellation of flights.

6 Identification Strategy

Two different methodologies are used to answer the main research question of this paper. These are difference-in-differences analysis and merger simulation using discrete choice structural demand estimation. To overcome the omitted variable bias, difference-in-differences analysis (DID) is particularly useful.

Table 2: Summary statistics pre-merger Period

Variable	Obs	Mean	Std. Dev.	Min	Max	P25	P50	P75
price	73142	395.14	107.82	84.09	1340.4	317.88	382.04	455.81
number of connections	73142	.97	.84	0	2	0	1	2
inconvenience	73142	1.07	.1	1	2.05	1	1.03	1.09
market distance	73142	2571.07	1218.51	694.6	5442.58	1623.02	2238.12	3469.27
hub status of origin airport	73142	.19	.32	0	1	0	0	.5
hub status of destination airport	73142	.19	.31	0	1	0	0	.5
distance	73142	2720.97	1264.37	692	6566.83	1724	2391.73	3650
no of products by other carriers	73142	2.86	2.37	0	17	1	2	4
total no of connections of products by other carriers	73142	3.04	2.92	0	20	0	2	5
total inconvenience of products by other carriers	73142	3.05	2.51	0	17.56	1.02	2.38	4.31
no of other carriers in the mkt	73142	1.75	1.27	0	7	1	2	2
average no of connections of products by other carriers	61902	1.05	.65	0	2	.5	1	1.5
average inconvenience of products by other carriers	61902	1.07	.08	1	1.99	1.02	1.05	1.09
Herfindahl Index	73142	.59	.23	.17	1	.42	.54	.73
hub status of connecting airport	73142	.31	.34	0	1	0	.21	.5

Table 3: Summary statistics post-merger period

Variable	Obs	Mean	Std. Dev.	Min	Max	P25	P50	P75
price	40848	380.71	121.05	65.31	1108.16	300.29	377.48	456.79
number of connections	40848	.88	.84	0	2	0	1	2
inconvenience	40848	1.07	.11	1	2.17	1	1.03	1.09
market distance	40848	2428.66	1234.41	502.27	5442.58	1457.02	2132.19	3334.04
hub status of origin airport	40848	.19	.32	0	1	0	0	.5
hub status of destination airport	40848	.19	.31	0	1	0	0	.5
distance	40848	2578.28	1284.5	502	7092	1599.1	2289.41	3488
no of products by other carriers	40848	2.79	2.43	0	15	1	2	4
total no of connections of products by other carriers	40848	2.73	2.77	0	15	0	2	4
total inconvenience of products by other carriers	40848	2.98	2.58	0	15.82	1	2.28	4.32
no of other carriers in the mkt	40848	1.7	1.3	0	6	1	2	3
average no of connections of products by other carriers	33344	.98	.65	0	2	.5	1	1.4
average inconvenience of products by other carriers	33344	1.07	.08	1	2.05	1.02	1.05	1.09
Herfindahl Index	40848	.59	.24	.18	1	.41	.53	.74
hub status of connecting airport	40848	.28	.32	0	1	0	.13	.5

While taking the second difference the confounding factors are dropped from both treatment and control. For DID analysis the design of treatment and control is particularly very important. I have done several robustness checks to make sure the design of the treatment and the control does not bias the results. Though DID analysis is a good method for identification of treatment effect it can not be used for counterfactual analysis. Since one of the objectives of the paper is to estimate the conduct parameter and cost savings by counterfactual simulation, I use a structural model as the second identification strategy.

6.1 Difference-in-Differences Analysis (DID):

I use the well known difference in differences analysis (see Ashenfelter & Card (1984), Card & Krueger (2000)) for calculating the effect of the merger while controlling for other factors. I calculate the difference in prices in routes operated by AA or US (treatment) between post (2016:Q1 to Q4) and the pre-merger period (2010: Q2 to 2012: Q2) and I also calculate the difference in prices in routes not operated by AA or US (control). I take the difference of those two. This will eliminate the effect of changes in cost and other general economic changes between the pre- and post-merger period and will give us the effect of the merger on price.

$$P_{jmt} = \gamma_m + \lambda_t + \delta * D_{mt} + \epsilon_{jmt} \tag{1}$$

In equation 1, P_{jmt} is the price of product j in market m and time t. γ_m is the intercept for markets or market fixed effects, λ_t is the intercept for time or time fixed effects, D_{mt} is the dummy variable indicating treatment status and ϵ_{jmt} is the error term. Under strict exogeneity assumption, it can be shown that the DID estimator is the following:

$$\begin{aligned}
\hat{\delta} &= \frac{1}{M}\sum_{m=1}^{M}\left(\bar{P_{m1}} - \bar{P_{m2}}\right) - \frac{1}{N}\sum_{n=1}^{N}\left(\bar{P_{n1}} - \bar{P_{n2}}\right) \\
\bar{P_{mt}} &= \sum_{j=1}^{J} P_{jmt} w_j \qquad \forall t = 1,2 \\
\bar{P_{nt}} &= \sum_{j=1}^{J} P_{jnt} w_j \qquad \forall t = 1,2
\end{aligned} \tag{2}$$

In Equation 2, M is the number of markets used as treatment and N is the number of markets used as a control and J is the number of products in the market m. w_j is the number of passengers used as a weight to calculate the average fare in a particular market.

7 Merger Simulation

Following the discrete choice random utility maximization framework (Hausman & McFadden (1984)) the own-price and cross-price elasticities can be estimated structurally using the pre-merger data. Using the demand parameter estimates I recover the marginal cost assuming a specific model of firm conduct. Then using the marginal cost and appropriately changing the ownership matrix I simulate the post-merger price and then compare the simulated post-merger price with the pre-merger price.

7.1 Model

I consider a discrete choice nested logit model for consumer demand in the airline industry following Peters (2006). The set up is also closely related to Berry & Jia (2010) and Berry et al. (2006). I follow closely the framework of Berry (1994) and Berry et al. (1995). This class of models assumes an interior, static price setting equilibrium to back out marginal cost and markup. I first compute the parameters of the demand model using the pre-merger data. I calculate the marginal cost assuming that all the firms are playing a static Bertrand-Nash game. Then, I use the computed marginal cost to numerically solve a new equilibrium in the post-merger period by changing the ownership matrix appropriately. Then I perform some counterfactuals by assuming different values for the cost savings.

7.1.1 Demand

Suppose a consumer i chooses from J different products offered in the market m by different competing airlines. The person also has the option of choosing an outside good without choosing any of the products offered by the airlines. A consumer maximizes her utility function while choosing among different products.

$$\max_{j\in(0,\ldots,J_m)} U_{ijm} = x_{jm}\beta - \alpha ln(p_{jm}) + \xi_{jm} + v_{it}(\lambda) + \lambda\epsilon_{ijm} \tag{3}$$

In Equation 3, U_{ijm} is the total utility that consumer i derives from choosing product j in market m. x_{jm} is a vector of observed product characteristics such as itinerary convenience (distance), whether the itinerary is nonstop or not, whether the origin airport is a hub for the carrier etc. β is the vector of parameters for the observed product characteristics. p_{jm} is the price of product j in market m. α represents the marginal utility of the log of the price. ξ_{jm} represents the unobserved (by the econometrician) product characteristics. ϵ_{ijm} is the random noise that is assumed to be identically and independently distributed across consumers, markets and products.

Following Berry (1994), I assume that the error term ϵ_{ijm} follows an extreme value Type I distribution. The term $v_{it}(\lambda)$ follows the distribution described by Cardell (1997). This distribution implies the nested logit form. The first nest contains the option of not flying or choosing between an outside good and an inside good. The second nest is among different products within a particular market. This type of setup assumes that some consumers are driven out of the market if the price is too high. The parameter λ determines the degree of within-market substitutability. If $\lambda \to 0$, it implies that products are more substitutable. On the other hand, if $\lambda \to 1$, it implies that products are independent and the nested logit model becomes the standard multinomial logit model. Following Berry (1994), I assume that the mean utility level of the outside good is zero. Also one of the limitations of the nested logit model is that I have to assume that consumers in all markets have the same values of α, β, and λ, i.e., I have to assume that consumers in Chicago have the same demand parameters as consumers in Miami.

Each consumer maximizes utility by choosing one of the products in each market. I define mean utility of product j of a consumer as the following

$$\delta_j = x_j\beta + \xi_j - \alpha ln(p_j) \tag{4}$$

where $j = 0$ is the outside good and $\delta_0 = 0$. The proportion of consumers choosing product j is equal to the probability of a consumer choosing product j among the set of products 1,2,...,J. The probability is given by

$$s_{j|g} = \frac{exp(\frac{\delta_j}{\lambda})}{\sum_{k=1}^{J} exp(\frac{\delta_k}{\lambda})} \tag{5}$$

By similar logic, the probability of a consumer flying is equal to the share of consumers purchasing flights. Thus, the probability of flying and the probability of choosing the outside good are following

$$
\begin{aligned}
s_g &= \frac{D^\lambda}{1+D^\lambda} \\
s_0 = 1 - s_g &= \frac{1}{1+D^\lambda}
\end{aligned}
\tag{6}
$$

where $D = \sum_{k=1}^{J} exp(\frac{\delta_k}{\lambda})$. The overall share of product j is given by

$$
s_j = s_{j|g} * s_g = \frac{exp(\frac{\delta_j}{\lambda}) D^{\lambda-1}}{1+D^\lambda} \tag{7}
$$

Following Berry (1994) I derive the estimating equation

$$
\begin{aligned}
\frac{s_j}{s_0} = \frac{s_g * s_{j|g}}{s_0} &= \left(\frac{D^\lambda}{D^\lambda+1}\right)\left(\frac{D^\lambda+1}{1}\right)\left(\frac{exp(\frac{\delta_j}{\lambda})}{D}\right) \\
&= D^{\lambda-1} exp(\frac{\delta_j}{\lambda}) \\
&= D^{\lambda-1}\left(exp(\frac{\delta_j}{\lambda})\right)^{1-\lambda}\left(exp(\frac{\delta_j}{\lambda})\right)^{\lambda} \\
&= \left(s_{j|g}\right)^{1-\lambda}\left(exp(\frac{\delta_j}{\lambda})\right)^{\lambda}
\end{aligned}
\tag{8}
$$

Then taking log on both sides gives

$$
ln(s_j) - ln(s_0) = x_j\beta - \alpha ln(p_j) + \xi_j + (1-\lambda) ln(s_{j|g}), \tag{9}
$$

The term ξ_j is considered as the random error term. This term, which represents the unobservable characteristics, will be correlated with price. Unobservable characteristics such as time of purchase, refund policy, and bigger leg room will be correlated with the price. I need to instrument for this endogeneity.

7.1.2 Instruments

Even though there is so much data available, due to DB1B, still many characteristics about flights are not observed, e.g., time of purchase, flight restrictions, in-flight service etc which are very likely to be correlated with the price and within group share. Following Berry (1994), I control for this endogeneity by instrumenting price with several different instruments.

In the literature, it is common to use input cost variables, since they are supposed to be correlated with the price but not correlated with the unobserved product characteristics. I include a fourth order polynomial in distance because of the direct relation of distance to the operating cost of a flight. Distance might affect demand by a number of connections which is included as an exogenous variable. Following Berry and Jia (2010), I also include hub status of the connecting airport as an instrument. The hub status of the connecting airport will affect cost through traffic density at the connecting airport while it will not be correlated with unobserved product characteristics.

According to Berry (1994), demand side variables that affect markups also can be used as an instrument. Characteristics of competing firm products can be used as instruments since they affect markup. I use the number of other carriers in the market, the number of products offered by other carriers in the market, the average number of connections of products offered by other carriers in the market, the average inconvenience of products offered by other carriers in the market, and market level HHI as demand-side instruments for price.

7.1.3 Supply

Following Berry & Jia (2010), I assume that firms play a static Bertrand-Nash price setting game. I use the first order conditions and the estimated demand parameters to back out the marginal cost of each product as in Berry et al. (1995). Suppose the total number of firms is $\mathcal{F}$ and each firm is producing subset $\mathcal{F}_f$ of J different products. The first order condition is given below

$$\begin{aligned} \pi_f &= \sum_{j \in \mathcal{F}_f} (p_j - mc_j) s_j(x, \xi, p, \theta_d) M - C_f \\ \frac{\partial \pi_f}{\partial p_j} &= s_j(p) + \sum_{r \in \mathcal{F}_f} (p_r - mc_r) \frac{\partial s_r(p)}{\partial p_j} = 0 \end{aligned} \tag{10}$$

where C_f is the total fixed cost of firm f, where mc_j is the marginal cost of product j produced by firm f, and where M is the overall market size. I define the matrix of the partial derivative of share with respect to price as $E(p)$ where $E_{jr}(p) = -\frac{\partial s_r(p)}{\partial p_j}$. I also define the pre-merger ownership matrix Ω as follows

$$\Omega_{jr} = \begin{cases} 1 & , \text{ if } \exists f : \{j, r\} \subset \mathcal{F}_f \\ 0 & , \text{ otherwise.} \end{cases} \tag{11}$$

Let Ω^{pre} be the element-by-element product of $E(p)$ and Ω, so that

$$\Omega_{jr}^{pre}(p) = \begin{cases} -\frac{\partial s_r(p)}{\partial p_j} & \text{, if } \exists f : \{j, r\} \subset \mathcal{F}_f \\ 0 & \text{, otherwise} \end{cases} \tag{12}$$

where $\frac{\partial s_r(p)}{\partial p_j}$ is given by

$$\frac{\partial s_r(p)}{\partial p_j} = \begin{cases} s_j s_{r|g} \left(\frac{\alpha}{p_j}\right)(1 - s_g - \frac{1}{\lambda}) & \text{, if } r \neq j \\ s_j \left(\frac{\alpha}{p_j}\right)\left(\frac{1}{\lambda}(1 - s_{j|g}) + s_{j|g}(1 - s_g)\right) & \text{, if } r = j. \end{cases} \tag{13}$$

Following this notation, I can write the first order condition as follows

$$s(p) - \Omega^{pre}(p)(p - mc) = 0. \tag{14}$$

Marginal cost is given by

$$\hat{mc} = p - (\hat{\Omega}^{pre})^{-1} s^{observed}. \tag{15}$$

7.1.4 Simulation

After estimating the marginal cost, I simulate the post-merger price by appropriately changing the ownership matrix and solving for optimal prices in an interior price setting equilibrium.

$$\hat{mc} = p' - \left(\Omega^{post}(p')\right)^{-1} s(p') \tag{16}$$

In equation 16, $\hat{mc}$ is the estimated marginal cost from pre-merger data. $\Omega^{post}(p')$ is the post-merger matrix defined by element-by-element multiplication of new ownership matrix Ω' and $E(p')$, where p' is the vector of post-merger equilibrium prices. I use numerical methods to solve for the post-merger equilibrium price.

I first assume that there is no cost synergy and there is no tacit collusion among the firms. I assume that the firms are playing a Nash-Bertrand game. I run counterfactual merger simulations with different levels of cost savings. Ciliberto & Williams (2014) analyze MMC and tacit collusion and they find that there is almost perfect coordination among airlines when MMC is very high. The paper also shows that modeling firm behavior as Bertrand-Nash competition produces biased estimates of marginal cost. I estimate the pair-wise conduct parameter between two airlines and then incorporate that in the merger simulation process. I find that part of the decrease in the price can be explained by reductions in co-operation among firms in the post-merger period and the other part can be explained by cost savings from the merger.

8 Estimation

I estimate demand for passenger air travel following Berry (1994). I first estimate the demand parameters using the nested logit demand model, and then I use those estimated parameters to estimate pre-merger marginal cost using the first order conditions of Nash-Bertrand Model. Then I simulate the American-US Airways merger by assuming different values of the cost synergy and by using the estimated level of tacit collusion among the firms.

8.1 Demand

I use the following equation to estimate the demand parameters.

$$ln(s_j) - ln(s_0) = x_j\beta - \alpha ln(p_j) + \xi_j + (1-\lambda)ln(s_{j|g}) + \epsilon_j \tag{17}$$

In equation 17, s_j is the share of product j and s_0 is the share of the outside good. x_j is the vector of exogenous product characteristics such as number of connections, the level of inconvenience (distance over market distance), and hub status of the origin and destination airport. I use the outside good in one nest, and the flights in another nest. The term ξ_j is the unobservable term which is almost certain to be correlated with price and within group market shares. I use several instruments such as distance, hub status of the connecting airport, and product characteristics of the competitors to control for the endogeneity problem.

8.2 Marginal Cost

After estimating the demand parameters, I use the following equation to calculate the marginal cost

$$\hat{mc} = p - (\hat{\Omega}^{pre})^{-1} s^{observed} \tag{18}$$

Then I use the different levels of cost savings and the estimated level of tacit collusion to run the counterfactual simulation to match the actual post-merger price with the simulated price.

9 Results

I list here the results from the two empirical strategies that I follow: 1) DID analysis, and 2) merger simulation.

9.1 DID Analysis

For DID analysis to be a appropriate methodology, it is important to check if there is a parallel price trend among the treatment and control groups.

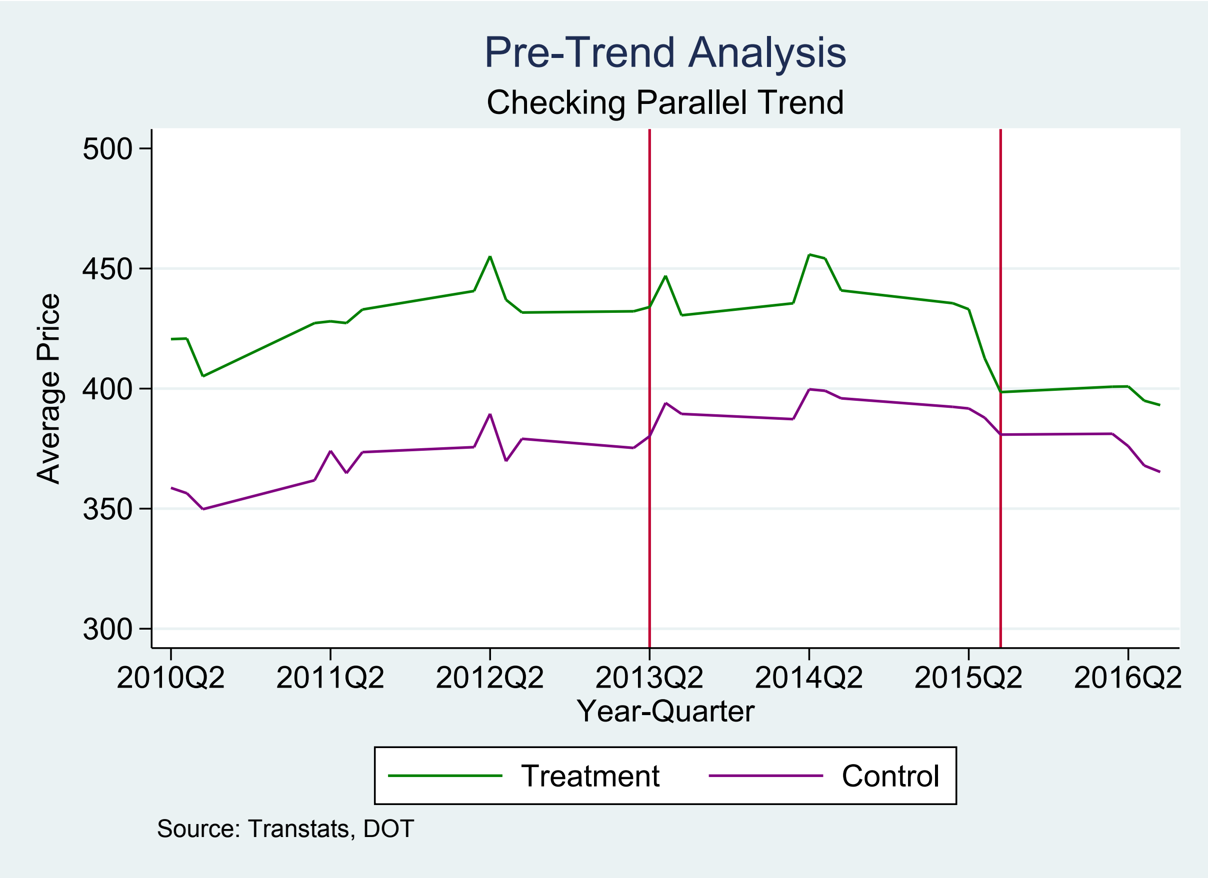


Figure 2: Pre-Trend Analysis

From Figure 2, we can see that the pre-trends among the treatment and the control group is parallel which means that the use of DID analysis to identify the effect of the merger is identified, and the results are less likely to suffer from bias.

In table 4, I list the DID statistics for price for different types of markets which are defined according to the number of passengers traveled[11]. The

[11]The first column considers all the markets where the number of passengers traveled is less than five thousands in a particular year and quarter. The second column considers all the markets where the number of passengers traveled is less than ten thousands and more than or equal to five thousands in a particular year and quarter. The third column considers all the markets where the number of passengers traveled is less than twenty-five thousands and more than or equal to ten thousands in a particular year and quarter. The fourth column considers all the markets where the number of passengers traveled is more than or equal to twenty-five thousands in a particular year and quarter. Finally, the fifth column consists of all the markets together for the analysis.

overall difference is around -9 (table 4 column 5) while the difference is larger for bigger markets (-23 in column 4). On the other hand, the difference is positive for smaller markets (21 in column 1) which means that the price did not go down in smaller markets due to the merger.

Table 4: Diff-in-diff Analysis : Price

	(1) price <5K	(2) price <10K&>5K	(3) price <25K&>10K	(4) price >25K	(5) price All
time	2.948	-4.842	-1.955	-0.335	-6.787***
	(1.26)	(-1.57)	(-0.67)	(-0.06)	(-3.37)
treated	38.84***	57.95***	66.36***	67.99***	45.60***
	(21.17)	(21.67)	(24.90)	(16.55)	(25.35)
did	21.46***	8.736*	-15.20***	-23.75***	-9.044***
	(6.50)	(1.88)	(-3.31)	(-3.27)	(-2.75)
_cons	372.7***	340.3***	304.5***	274.1***	322.8***
	(294.08)	(184.43)	(182.37)	(94.25)	(302.44)
N	19628	8609	7356	2663	38256
adj. R^2	0.048	0.084	0.106	0.102	0.047

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 5, I list the DID statistics for price for different types of markets with divestiture as another control variable. The overall difference is around -9.23 while the difference is larger for bigger markets. On the other hand, the difference is positive for smaller markets which means that the price did not go down in smaller markets due to the merger unlike the bigger markets. We can also see that divestiture has a negative significant impact on price in both smaller and larger markets. So we can see that divestiture has a very effective role in reducing the price across all types of city-pair markets.

Table 5: Diff-in-diff Analysis: Divestiture

	(1) price	(2) price	(3) price	(4) price	(5) price
time	2.917	-4.849	-1.911	-0.264	-6.497***
	(1.25)	(-1.58)	(-0.65)	(-0.05)	(-3.23)
treated	38.87***	57.85***	66.41***	69.37***	47.61***
	(21.19)	(21.54)	(24.78)	(16.29)	(26.15)
did	21.45***	8.815*	-15.24***	-23.90***	-9.227***
	(6.49)	(1.89)	(-3.32)	(-3.30)	(-2.83)
divest	-24.11***	8.465	-2.187	-10.60**	-33.20***
	(-3.48)	(1.01)	(-0.33)	(-2.22)	(-8.73)
_cons	372.7***	340.3***	304.5***	274.1***	322.9***
	(293.82)	(184.42)	(182.36)	(94.24)	(302.42)
N	19628	8609	7356	2663	38256
adj. R^2	0.048	0.084	0.106	0.103	0.051

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 6, I list the DID statistics for frequency of flights for different types of markets. The overall difference is around -9 but the coefficient is not statistically significant. On the other hand, the difference is positive for medium sized markets and negative for small and large markets but none of the coefficients are statistically significant.

Table 6: Diff-in-diff Analysis : Frequency of Flights

	(1) freq <5K	(2) freq <10K&>5K	(3) freq <25K&>10K	(4) freq >25K	(5) freq All
time	-31.72***	-25.90***	-51.07***	-11.44	-35.51***
	(-6.49)	(-3.11)	(-4.18)	(-0.33)	(-5.29)
treated	56.79***	52.66***	-35.82***	285.0***	113.8***
	(13.69)	(9.32)	(-4.48)	(13.69)	(23.03)
did	-6.093	2.129	14.90	-57.29	-9.230
	(-0.82)	(0.20)	(0.96)	(-1.28)	(-0.95)
_cons	224.1***	393.2***	744.2***	1155.9***	484.8***
	(82.74)	(91.29)	(119.72)	(74.64)	(143.92)
N	18954	14888	15269	5952	55063
adj. R^2	0.016	0.009	0.003	0.027	0.013

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 7, I list the DID statistics for number of seats available for different types of markets. The overall difference is around -754 but it is not statistically significant. On the other hand, the difference is positive for small and medium sized markets but negative for large markets but none of those are statistically significant.

Table 7: Diff-in-diff Analysis : Number of Seats

	(1) seat <5K	(2) seat <10K&>5K	(3) seat <25K&>10K	(4) seat >25K	(5) seat All
time	-802.1	696.8	297.4	5221.5	139.0
	(-1.29)	(0.61)	(0.16)	(1.02)	(0.14)
treated	1138.3***	2765.7***	-5218.1***	32955.6***	12373.2***
	(2.73)	(3.93)	(-4.79)	(11.41)	(17.99)
did	210.4	424.0	459.9	-3782.4	-754.8
	(0.26)	(0.29)	(0.20)	(-0.60)	(-0.54)
_cons	22126.7***	47378.7***	98192.2***	166892.0***	61015.1***
	(70.56)	(86.36)	(114.03)	(73.07)	(127.72)
N	18954	14888	15269	5952	55063
adj. R^2	0.001	0.001	0.002	0.021	0.007

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 8, I list the DID statistics for delay in departure (Total minutes delay in a quarter in a city-pair market) for different types of markets. The overall difference is around 382 but it is not statistically significant. On the other hand, the difference is positive for small and large markets but negative for medium sized markets but none of those are statistically significant.

Table 8: Diff-in-diff Analysis : Delay in Departure

	(1) DD <5K	(2) DD <10K&>5K	(3) DD <25K&>10K	(4) DD >25K	(5) DD All
time	-18.89	310.7**	918.4***	1761.6***	529.2***
	(-0.18)	(2.16)	(4.52)	(2.64)	(4.09)
treated	400.7	-14.49	475.2	2806.9***	1889.2***
	(1.22)	(-0.05)	(1.27)	(3.00)	(5.30)
did	87.39	-97.93	-317.7	589.3	382.1
	(0.16)	(-0.25)	(-0.54)	(0.42)	(0.68)
_cons	1480.4***	2097.3***	3440.5***	6690.5***	2829.4***
	(19.15)	(22.53)	(27.70)	(14.91)	(34.09)
N	810	851	944	372	2979
adj. R^2	0.001	0.002	0.020	0.071	0.039

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 9, I list the DID statistics for delay in arrival (Total minutes delay in a quarter in a city-pair market) for different types of markets. The overall difference is around 279 but it is not statistically significant. On the other hand, the difference is positive for small and large markets but negative for medium sized markets but none of those are statistically significant.

Table 9: Diff-in-diff Analysis : Delay in Arrival

	(1) DA <5K	(2) DA <10K&>5K	(3) DA <25K&>10K	(4) DA >25K	(5) DA All
time	-46.99	317.7**	995.8***	2067.0***	575.9***
	(-0.42)	(2.09)	(4.63)	(2.61)	(3.94)
treated	536.0	102.5	893.0**	3344.1***	2376.4***
	(1.41)	(0.35)	(2.19)	(3.31)	(6.02)
did	160.5	-118.1	-384.6	47.49	279.6
	(0.26)	(-0.27)	(-0.61)	(0.03)	(0.46)
_cons	1644.7***	2294.0***	3776.6***	7688.3***	3146.2***
	(19.56)	(23.01)	(28.45)	(14.63)	(33.58)
N	810	851	944	372	2979
adj. R^2	0.004	0.002	0.025	0.064	0.044

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 10, I list the DID statistics for number of cancellations for different types of markets. The overall difference is around -2 and it is statistically significant. On the other hand, the difference is bigger large markets. The difference is not statistically significant for smaller markets.

Table 10: Diff-in-diff Analysis : Cancellation of Flights

	(1) NoC <5K	(2) NoC <10K&>5K	(3) NoC <25K&>10K	(4) NoC >25K	(5) NoC All
time	-0.771***	-0.349***	-0.664***	-0.543	-0.607***
	(-7.22)	(-2.95)	(-2.90)	(-0.46)	(-3.81)
treated	0.822	0.693*	1.282***	6.299***	3.192***
	(1.49)	(1.84)	(3.04)	(3.00)	(4.99)
did	-0.184	-0.763*	-1.144**	-6.370***	-2.285***
	(-0.26)	(-1.81)	(-2.23)	(-2.69)	(-3.32)
_cons	1.133***	1.102***	2.189***	5.614***	1.934***
	(11.41)	(11.09)	(12.61)	(7.74)	(17.62)
N	810	851	944	372	2979
adj. R^2	0.070	0.020	0.023	0.040	0.037

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

9.2 Merger Simulation

9.2.1 Demand

In table 11, I list the results of the demand estimation. Almost all the coefficients are statistically significant and have the expected sign as well. The coefficient of the log of fare is -2.92 and it is significant at the 1% level. Similarly, the log of within-group share is also significant at the 1% level. The estimated value of λ is .345 which indicates that the products are substitutable with each other and it invalidates the standard multinomial logit model which assumes that products are independent. Consumers also prefer fewer connections as the coefficient on connections is negative and significant. Also, the hub variables are significant and the coefficients have positive sign.

Table 11: Demand Estimation:2SLS

log of fare	-2.920***
	(0.0898)
log of within group share	0.655***
	(0.00813)
connections	-0.209***
	(0.00699)
inconvenience	-0.386***
	(0.0411)
market distance	0.0437***
	(0.00128)
origin is a hub	0.896***
	(0.0341)
origin is a hub*market distance	0.00179**
	(0.000866)
destination is a hub	0.413***
	(0.0276)
destination is a hub*market distance	0.00296***
	(0.000853)
constant	14.95***
	(0.481)
N	61902
adj. R^2	0.784

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

I calculate the elasticity of demand for different markets using the estimated value of parameters α and λ. I find that the average own-price elasticity in overlapping markets is -7.14 and average cross-price elasticity is 1.39. Table 12 shows the elasticity measure in a particular market.

Table 12: Elasticity Matrix of ORD-PHX Market, 2012 Q2

Carrier	**Passengers**	**Fare**	**Connections**						**Elasticity**
American	610	454.49	One	-8.3	2.5	1.3	.2	.03	1.7
American	18310	423.75	Non stop	0.1	-5.7	1.4	.2	.03	1.9
United	9520	422.63	Non stop	0.1	2.7	-7.0	.2	.03	1.8
United	950	510.43	One	0.1	2.3	1.2	-8.3	.03	1.5
US Airways	160	595.37	One	0.1	1.9	1.0	.12	-8.4	1.3
US Airways	13570	388.21	Non stop	.1	2.9	1.5	.18	.04	-6.5

9.2.2 Marginal Cost

I use equation 18 to calculate the marginal cost. Then I use the calculated marginal cost and equation 16 to solve numerically for the post-merger price. I compare the simulated price with the pre-merger price to measure the extent of the price change. I also compare actual post-merger price with pre-merger price. Then I run counterfactual simulations with different values of cost reduction both common across all firms and specific to the merged firm.

9.2.3 Conduct

I estimate the conduct parameter pairwise from the multimarket contact between the carriers following Ciliberto & Williams (2014). The number of overlapping markets between two carriers are given in table 13 and table 14 in the appendix. The following equation 19 is used to estimate the conduct between two carriers as in Ciliberto & Williams (2014).

$$f(mmc_{kh}^t) = \frac{\exp(\phi_1 + \phi_2 mmc_{kh}^t)}{1 + \exp(\phi_1 + \phi_2 mmc_{kh}^t)} \quad (19)$$

In equation 19 mmc_{kh}^t is the multi-market contact between carrier k and carrier h at time period t. ϕ_1 and ϕ_2 are constants. The estimated pairwise conduct parameters are shown in tables 15 and 16. The conduct parameter value is higher for the carriers having a higher number of overlapping markets. I use this estimated conduct parameter to simulate the post-merger price. The results are shown in table 17.

Table 13: No of Overlapping Markets: 2012 Q2

	DL	US	AA	UA	AS	B6	F9	G4	NK	SY	VX	WN
DL	1194	446	302	369	32	112	109	7	56	27	18	720
US	446	754	195	333	19	59	57	0	26	9	23	372
AA	302	195	598	355	31	42	26	1	40	5	30	245
UA	369	333	355	873	59	57	130	9	37	4	46	426
AS	32	19	31	59	126	11	7	7	5	1	21	71
B6	112	59	42	57	11	162	0	0	13	0	13	64
F9	109	57	26	130	7	0	219	2	9	5	0	149
G4	7	0	1	9	7	0	2	23	2	0	0	0
NK	56	26	40	37	5	13	9	2	82	1	4	29
SY	27	9	5	4	1	0	5	0	1	27	0	15
VX	18	23	30	46	21	13	0	0	4	0	49	25
WN	720	372	245	426	71	64	149	0	29	15	25	1151

Table 14: No of Overlapping Markets: 2016 Q2

	DL	US	AA	UA	AS	B6	F9	G4	NK	SY	VX	WN
DL	1348	0	821	385	120	152	170	1	159	32	29	791
US	0	0	0	0	0	0	0	0	0	0	0	0
AA	821	0	1201	453	50	114	147	0	155	19	33	599
UA	385	0	453	746	57	50	156	1	131	12	44	346
AS	120	0	50	57	188	8	13	1	14	4	10	121
B6	152	0	114	50	8	224	3	0	34	0	16	82
F9	170	0	147	156	13	3	263	1	45	6	13	148
G4	1	0	0	1	1	0	1	3	0	0	0	1
NK	159	0	155	131	14	34	45	0	253	14	7	124
SY	32	0	19	12	4	0	6	0	14	32	0	16
VX	29	0	33	44	10	16	13	0	7	0	64	30
WN	791	0	599	346	121	82	148	1	124	16	30	1153

Table 15: Estimated Conduct: 2012 Q2

	DL	US	AA	UA	AS	B6	F9	G4	NK	SY	VX	WN
DL	1.00	0.60	0.32	0.44	0.05	0.09	0.09	0.04	0.06	0.05	0.05	0.93
US	0.60	1.00	0.17	0.37	0.05	0.06	0.06	0.04	0.05	0.04	0.05	0.45
AA	0.32	0.17	1.00	0.42	0.05	0.06	0.05	0.04	0.05	0.04	0.05	0.23
UA	0.44	0.37	0.42	1.00	0.06	0.06	0.11	0.04	0.05	0.04	0.06	0.56
AS	0.05	0.05	0.05	0.06	1.00	0.04	0.04	0.04	0.04	0.04	0.05	0.07
B6	0.09	0.06	0.06	0.06	0.04	1.00	0.04	0.04	0.04	0.04	0.04	0.06
F9	0.09	0.06	0.05	0.11	0.04	0.04	1.00	0.04	0.04	0.04	0.04	0.12
G4	0.04	0.04	0.04	0.04	0.04	0.04	0.04	1.00	0.04	0.04	0.04	0.04
NK	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.04	1.00	0.04	0.04	0.05
SY	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	1.00	0.04	0.04
VX	0.05	0.05	0.05	0.06	0.05	0.04	0.04	0.04	0.04	0.04	1.00	0.05
WN	0.93	0.45	0.23	0.56	0.07	0.06	0.12	0.04	0.05	0.04	0.05	1.00

Table 16: Estimated Conduct: 2016 Q2

	DL	US	AA	UA	AS	B6	F9	G4	NK	SY	VX	WN
DL	1.00	0.04	0.97	0.48	0.10	0.12	0.14	0.04	0.13	0.05	0.05	0.96
US	0.04	1.00	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
AA	0.97	0.04	1.00	0.61	0.06	0.09	0.12	0.04	0.13	0.05	0.05	0.83
UA	0.48	0.04	0.61	1.00	0.06	0.06	0.13	0.04	0.11	0.04	0.06	0.40
AS	0.10	0.04	0.06	0.06	1.00	0.04	0.04	0.04	0.04	0.04	0.04	0.10
B6	0.12	0.04	0.09	0.06	0.04	1.00	0.04	0.04	0.05	0.04	0.05	0.07
F9	0.14	0.04	0.12	0.13	0.04	0.04	1.00	0.04	0.06	0.04	0.04	0.12
G4	0.04	0.04	0.04	0.04	0.04	0.04	0.04	1.00	0.04	0.04	0.04	0.04
NK	0.13	0.04	0.13	0.11	0.04	0.05	0.06	0.04	1.00	0.04	0.04	0.10
SY	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	1.00	0.04	0.05
VX	0.05	0.04	0.05	0.06	0.04	0.05	0.04	0.04	0.04	0.04	1.00	0.05
WN	0.96	0.04	0.83	0.40	0.10	0.07	0.12	0.04	0.10	0.05	0.05	1.00

Table 17: With Tacit Collusion in Pre-merger and Post-merger Period

Cost Saving	**Industry**					
Merger	**0%**	**2.5%**	**5%**	**7.5%**	**10%**	**12.5%**
0%	2.9	-0.2	-2.4	-4.8	-7.2	-9.7
2.5%	1.5	-0.7	-3.3	-5.8	-8.2	-10.7
5%	0.5	-1.3	-3.9	-6.3	-8.7	-11.2
7.5%	-0.1	-2.5	-4.7	-7.1	-9.5	-11.9
10%	-1.0	-3.4	-5.4	-7.6	-10.4	-12.5
12.5%	-1.8	-3.9	-6.5	-8.6	-11.1	-13.4

The actual decrease in price is 8% approximately when I compare the pre-merger and post-merger price in the overlapping city-pair markets. From table 17, we can see that a cost reduction of 10% in the industry is required to match the actual decrease in price if we assume that there is no cost reduction due to the merger. A cost reduction of 7.5% across all firms and a reduction of 10% specific to the merged firm are able to produce the actual post-merger price quite closely. In table 19 there is tacit collusion among firms in the pre-merger period but not in the post-merger period. We can see that with tacit collusion only in the pre-merger period the reduction in price with the same level of cost saving is 2% higher compared to table 17. I show that with average conduct level of .4 this cost reduction will be even more compared to cost saving using pairwise conduct parameter in table 20. This shows the existence of another channel through which price reduction is possible apart from cost saving. This result suggests that the possibility is strong that the firms were operating with some level of tacit co-operation and they might not have been acting as Nash-Bertrand competitors in the pre-merger period.

Table 18: With Nash-Bertrand in Pre-merger and Post-merger Period

Cost Saving	**Industry**					
Merger	**0%**	**2.5%**	**5%**	**7.5%**	**10%**	**12.5%**
0%	2.5	-0.5	-2.5	-5.0	-7.5	-9.9
2.5%	1.5	-0.8	-3.6	-5.9	-8.5	-10.9
5%	0.6	-1.4	-4.4	-6.5	-9	-11.5
7.5%	-0.4	-2.6	-4.8	-7.3	-9.7	-12.2
10%	-1.1	-3.5	-5.6	-7.9	-10.5	-12.7
12.5%	-1.9	-4.2	-6.6	-8.7	-11.2	-13.6

Table 19: With Tacit Collusion only in Pre-merger Period (pairwise)

Cost Saving	**Industry**					
Merger	**0%**	**2.5%**	**5%**	**7.5%**	**10%**	**12.5%**
0%	1.8	-0.8	-3.3	-5.6	-8.2	-10.5
2.5%	1.1	-1.2	-3.9	-6.7	-8.7	-11.1
5%	0.3	-2.2	-4.9	-7.1	-9.4	-11.9
7.5%	-0.6	-2.9	-5.2	-7.6	-10.1	-12.7
10%	-1.5	-3.8	-6.1	-8.6	-10.9	-13.1
12.5%	-2.1	-4.8	-6.7	-9.4	-11.2	-14.1

Table 20: With Tacit Collusion only in Pre-merger Period (average level)

Cost Saving	**Industry**			
Merger	**0%**	**2.5%**	**5%**	**7.5%**
0%	-4.8	-6.8	-9.4	-11.5
2.5%	-5.5	-8.1	-10.4	-12.5
5%	-6.5	-8.4	-10.8	-13.1
7.5%	-7.2	-9.3	-11.7	-13.5

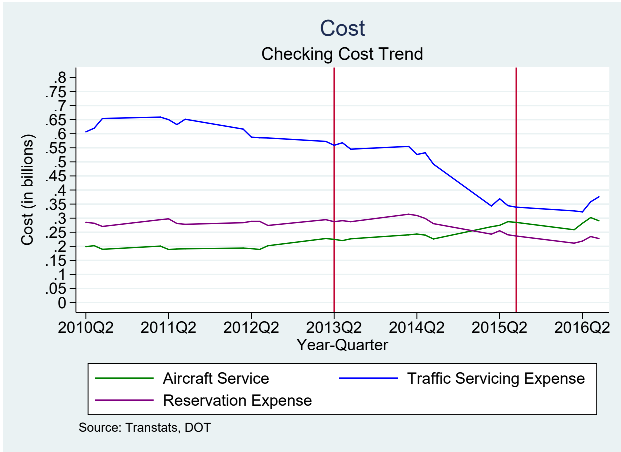
10 Cost

This section analyzes the operating cost of the airlines. If there is any efficiency gain due to the merger it might be reflected on the accounting cost. This cost data is taken from the schedule P-7 of Air Carrier Financial Statistics reported to the DOT. In general there are always concerns regarding the validity of accounting cost data for economic analysis. To see if the accounting cost data is reliable I matched the estimated total variable cost from the simulation to the actual cost reported by the airlines and I find that the figures are similar.

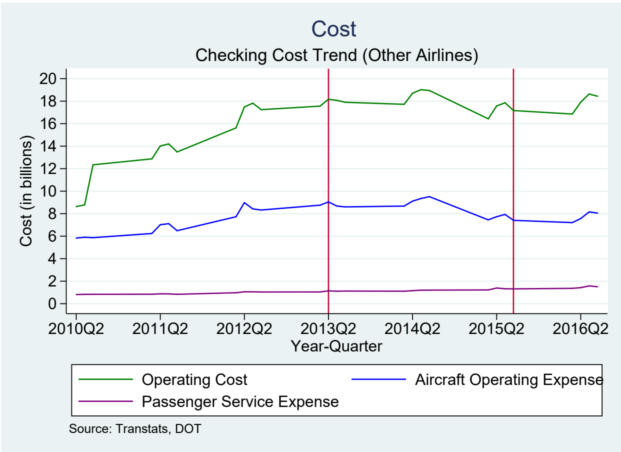
I have plotted the different types of costs against the year-quarter combination for AA-US combined and for the other airlines separately. It is clear from the Figure 3b and Figure 3d in the appendix that there is some downward trend for operating cost and traffic servicing expense for the merging airlines. On the other hand the downward trend is missing from the the cost data of the other airlines. This downward trend in cost might be due to the efficiency in cost reduction due to the merger.

I also plotted the fuel cost per gallon over time and it is very clear from Figure 5 that there is substantial reduction in jet fuel price during the period of the merger which reduced the general airline ticket price during that time.

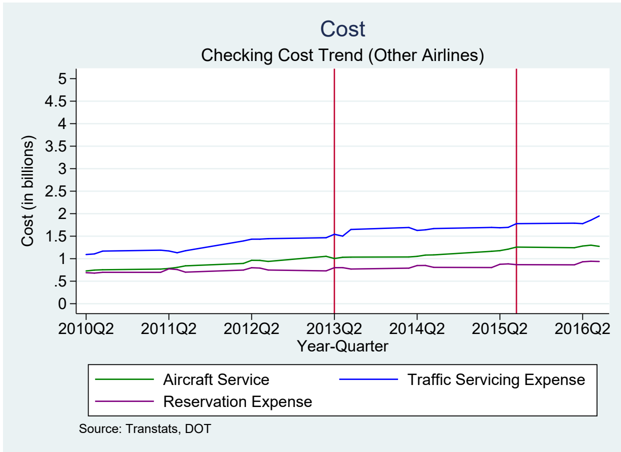
(a)



(b)

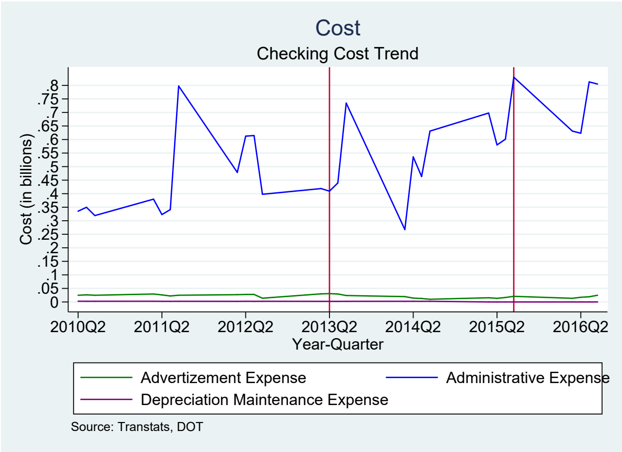


(c)

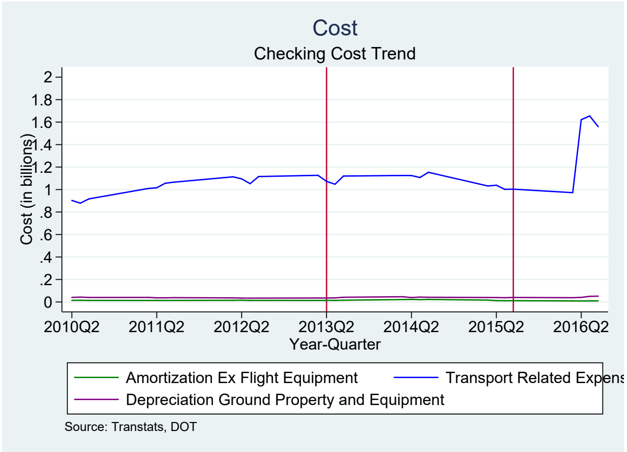


(d)

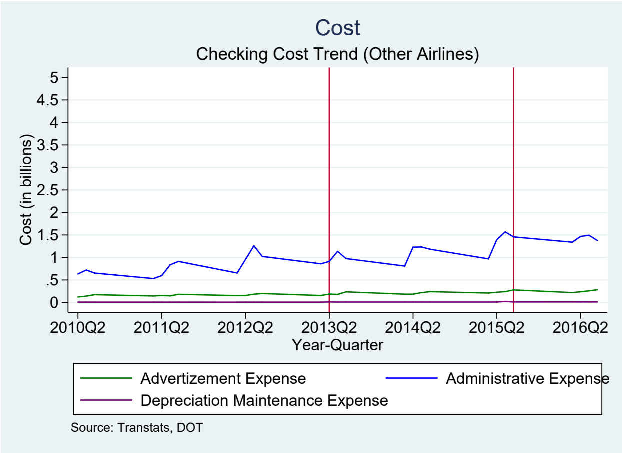
Figure 3



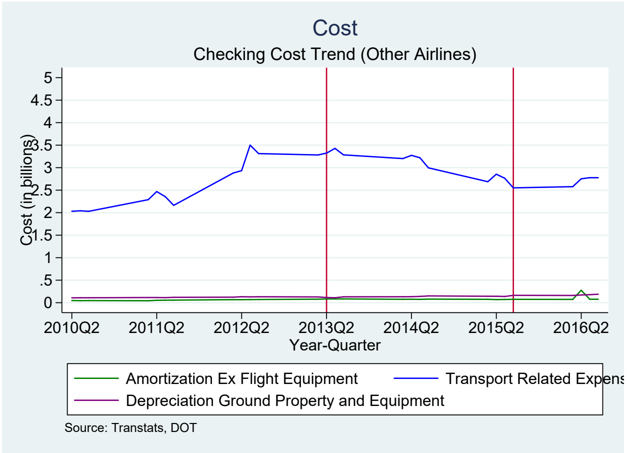
(a)



(b)



(c)



(d)

Figure 4

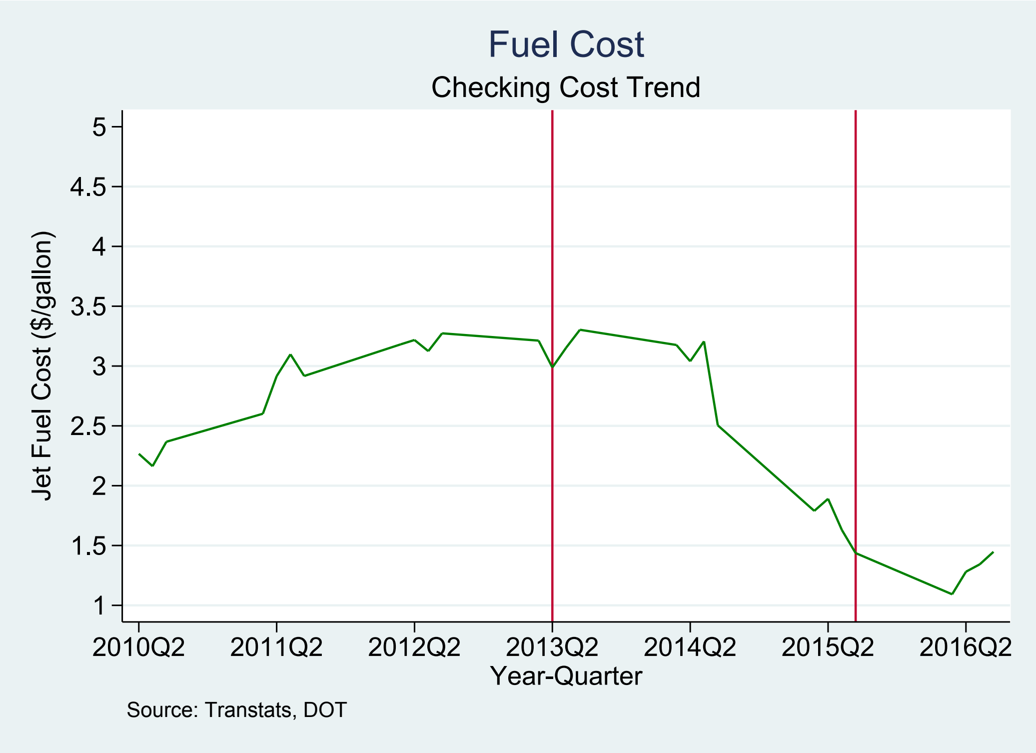


Figure 5

11 Conclusion

From the difference-in-differences analysis we can see that merger has a significant negative effect on the price in the larger markets. Smaller markets have not benefited from the merger in terms lower price. Slot divestiture has helped to reduce the price. I also find that the merger has no significant effect on the frequency of flights in the nonstop markets. The merger has no effect on delay in departure or arrival but it does have significant effect in reducing the number of cancellations in the larger markets. From difference-in-differences analysis, I can claim that the merger between American and US Airways has been beneficial to the consumers in terms lower average price and less number of canceled flights in the larger markets while the smaller markets have not benefited.

From the merger simulation, I find that the change in the market structure, assuming no cost reduction, leads to a 3% increase in price. Given that the actual post-merger price has decreased after the merger, either there must be cost reduction from the merger or cost must have gone down at the industry level for all firms. The other possibility is the breakdown of tacit collusion among the firms in the post-merger period. I find that a combination of 7% cost reduction for all firms, 10% cost savings due to merger, and estimated conduct parameter is able to predict the post-merger price quite accurately.

It will be valuable to come up with some kind of estimate of the marginal cost of the airlines. If we can estimate the marginal cost of the airlines, we can identify the conduct parameter in a different way, and we can reexamine the extent of tacit collusion among the airlines. A breakdown of price co-operation in the post-merger period might contribute to the observed reduction in price apart from cost saving due to merger and reduction in jet fuel cost.

Some limitations need to be acknowledged. First, even though my paper attempts to analyze the conduct parameter, the analysis is still under the framework of Nash-Bertrand competition. It will be interesting to build a model to capture cooperation among firms in a more direct way. Second, my analysis does not incorporate the inter-temporal pricing decisions of the airlines. Third, the data provided by DOT is quarterly data which might raise the issue of aggregation bias.

References

Abramowitz, A. D. & Brown, S. M. (1993), 'Market share and price determination in the contemporary airline industry', *Review of Industrial Organization* **8**(4), 419–433.

Ashenfelter, O. C. & Card, D. (1984), 'Using the longitudinal structure of earnings to estimate the effect of training programs'.

Berry, S., Carnall, M. & Spiller, P. (2006), 'Airline hubs: costs, markups and the implications of customer heterogeneity', *Advances in airline economics* **1**, 183–214.

Berry, S. & Jia, P. (2010), 'Tracing the woes: An empirical analysis of the airline industry', *American Economic Journal: Microeconomics* **2**(3), 1–43.

Berry, S., Levinsohn, J. & Pakes, A. (1995), 'Automobile prices in market equilibrium', *Econometrica* pp. 841–890.

Berry, S. T. (1994), 'Estimating discrete-choice models of product differentiation', *RAND Journal of Economics* pp. 242–262.

Bilotkach, V. (2011), 'Multimarket contact and intensity of competition: evidence from an airline merger', *Review of Industrial Organization* **38**(1), 95–115.

Borenstein, S. (1989), 'Hubs and high fares: dominance and market power in the us airline industry', *RAND Journal of Economics* pp. 344–365.

Borenstein, S. (1990), 'Airline mergers, airport dominance, and market power', *American Economic Review* **80**(2), 400–404.

Borenstein, S. & Rose, N. L. (2008), 'How airline markets work... or do they? regulatory reform in the airline industry'.

Capps, C. & Dranove, D. (2004), 'Hospital consolidation and negotiated ppo prices', *Health Affairs* **23**(2), 175–181.

Card, D. & Krueger, A. B. (2000), 'Minimum wages and employment: a case study of the fast-food industry in new jersey and pennsylvania: reply', *American Economic Review* **90**(5), 1397–1420.

Cardell, N. S. (1997), 'Variance components structures for the extreme-value and logistic distributions with application to models of heterogeneity', *Econometric Theory* **13**(02), 185–213.

Carlton, D. W., Landes, W. M. & Posner, R. A. (1980), 'Benefits and costs of airline mergers: a case study', *Bell Journal of Economics* pp. 65–83.

Chen, Y. & Gayle, P. (2013), 'Mergers and product quality: Evidence from the airline industry'.

Ciliberto, F. & Williams, J. W. (2014), 'Does multimarket contact facilitate tacit collusion? inference on conduct parameters in the airline industry', *RAND Journal of Economics* **45**(4), 764–791.

Dafny, L. (2009), 'Estimation and identification of merger effects: An application to hospital mergers', *Journal of Law and Economics* **52**(3), 523–550.

Evans, W. N. & Kessides, I. N. (1993), 'Localized market power in the us airline industry', *Review of Economics and Statistics* pp. 66–75.

Farrell, J. & Shapiro, C. (1990), 'Horizontal mergers: an equilibrium analysis', *American Economic Review* pp. 107–126.

Focarelli, D. & Panetta, F. (2003), 'Are mergers beneficial to consumers? evidence from the market for bank deposits', *The American Economic Review* **93**(4), 1152–1172.

Hausman, J. & McFadden, D. (1984), 'Specification tests for the multinomial logit model', *Econometrica* pp. 1219–1240.

Ho, V. & Hamilton, B. H. (2000), 'Hospital mergers and acquisitions: does market consolidation harm patients?', *Journal of Health Economics* **19**(5), 767–791.

Kahn, C., Pennacchi, G. & Sopranzetti, B. (2005), 'Bank consolidation and the dynamics of consumer loan interest rates', *Journal of Business* **78**(1), 99–134.

Kim, E. H. & Singal, V. (1993), 'Mergers and market power: Evidence from the airline industry', *American Economic Review* pp. 549–569.

Krishnan, R. (2001), 'Market restructuring and pricing in the hospital industry', *Journal of Health Economics* **20**(2), 213–237.

Kwoka, J. & Shumilkina, E. (2010), 'The price effect of eliminating potential competition: Evidence from an airline merger', *Journal of industrial economics* **58**(4), 767–793.

Mayer, C. & Sinai, T. (2003), 'Network effects, congestion externalities, and air traffic delays: Or why not all delays are evil', *American Economic Review* **93**(4), 1194–1215.

Mazzeo, M. J. (2003), 'Competition and service quality in the us airline industry', *Review of industrial Organization* **22**(4), 275–296.

Morrison, S. A. (1996), 'Airline mergers: A longer view', *Journal of Transport Economics and Policy* pp. 237–250.

Peters, C. (2006), 'Evaluating the performance of merger simulation: Evidence from the us airline industry', *Journal of law and economics* **49**(2), 627–649.

Prager, R. A. & Hannan, T. H. (1998), 'Do substantial horizontal mergers generate significant price effects? evidence from the banking industry', *Journal of Industrial Economics* **46**(4), 433–452.

Prince, J. T. & Simon, D. H. (2009), 'Multimarket contact and service quality: Evidence from on-time performance in the us airline industry', *Academy of Management Journal* **52**(2), 336–354.

Rupp, N. G. & Holmes, G. M. (2006), 'An investigation into the determinants of flight cancellations', *Economica* **73**(292), 749–783.

Rupp, N., Owens, D., Plumly, L. et al. (2006), 'Does competition influence airline on-time performance', *Advances in airline economics* **1**, 251–272.

Sapienza, P. (2002), 'The effects of banking mergers on loan contracts', *Journal of finance* **57**(1), 329–367.

Vogt, W. B. & Town, R. (2006), 'How has hospital consolidation affected the price and quality of hospital care?'.

Werden, G. J., Joskow, A. S. & Johnson, R. L. (1991), 'The effects of mergers on price and output: Two case studies from the airline industry', *Managerial and Decision Economics* **12**(5), 341–352.

Williamson, O. E. (1968), 'Economies as an antitrust defense: The welfare tradeoffs', *American Economic Review* **58**(1), 18–36.