

Effects of Mergers and Divestitures on Airline Fares

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U.S. antitrust authorities have increasingly forced merging companies to divest assets as a condition for merger approval, with the goal of creating a more competitive postmerger environment. This study examined the effectiveness of this government strategy in the context of the airline industry, in which forced divestitures have occurred in recent consolidations. The study used unique data on assets critical to airport facilities that were involved in the divestitures to document the reallocation of those assets to low-cost carriers. Estimates of the impact of the divestitures on airfares were then calculated. The results show that, at the affected airports, fares for merging carriers fell by 3% and fares for nonmerging carriers fell by 1% relative to airports at which no divestiture occurred. These results provide evidence that the divestiture strategy used by antitrust authorities is effective in this setting in mitigating market power.

The airline industry has experienced an intense process of consolidation in the past few years. In 2008, the United States had six legacy airlines: American (AA), Continental (CO), Delta (DL), Northwest (NW), United (UA), and US Airways (US); by 2015, it had only three: AA, DL, and UA. This consolidation process also occurred with low-cost carriers: America West (HP, until the third quarter 2005) merged with US in 2005; Southwest Airlines (WN) merged with AirTran in 2014; and ATA ceased operations in 2008. By 2015, the three remaining legacy carriers and WN together controlled 80% of the airline traffic in the continental United States. This consolidation has raised antitrust concerns, with the Department of Justice (DOJ) submitting civil investigative demands to the four large carriers in July 2015. DOJ demanded copies of all communications between the airlines, analysts, and shareholders in an attempt to learn if anti-competitive behavior was behind the slowdown in capacity growth and high fares.

A natural solution to address antitrust concerns is to promote the entry of low-cost carriers into airline markets, so as to help allay collusive or monopolistic practices by the four largest carriers. In recent airline merger cases, DOJ has forced airlines to divest assets at concentrated airports, primarily boarding gates and landing slots, to encourage entry by low-cost carriers, as a condition for approval of a merger. For example, in April 2014, DOJ announced that it would require AA and US to divest slots, gates, and ground facilities at key airports as a condition of their merger.

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This forced divestiture of airline assets at airports is consistent with the idea that access to airport facilities is a crucial component of the extent of entry and, by extension, competition in airline markets (1, 2). In the merger between AA and US, DOJ forced the merged airline to divest assets, including boarding gates and landing slots at many of the most concentrated and essential airports [e.g., Reagan Washington International and LaGuardia International], which are also airports that have the highest barriers to entry for low-cost carriers. Unfortunately, the lack of publicly available information on the control of these assets has created difficulty for academic researchers trying to study the effect (if any) of the steps taken by DOJ to lessen antitrust concerns surrounding such mergers.

This study built a new data set, with current and historical information, on the type of access to facilities that airlines have at U.S. airports. The airports belong to the Airport Council International—North America, which represents nearly all top-200 airports in number of enplanements and helped the current authors in surveying the airports.

The new data set was used to examine the relationship between market structure and access to airport facilities. Specifically, the research looked at how forced divestiture of access to gates from a merger affected competition between airlines in two stages. First, the research analyzed the effect of mergers and bankruptcies on airlines' access to gates; it confirmed that the divestitures occurred and determined the airlines that gained the divested assets. Second, the research studied the effect of this change in access on airline competition in relation to fares. Among the findings was that, after divestiture took place, fares for merging carriers fell by 3% on flights with an endpoint at an airport where DOJ forced divestiture compared with fares for flights on the same carrier with endpoints at airports unaffected by divestiture. Similarly, fares for nonmerging carriers also fell after divestiture took place by 1% relative to fares for flights with an endpoint at unaffected airports. These results suggest that divestiture is effective as a remedy to anticompetitive aspects of airline mergers.

LITERATURE REVIEW

Early research by academics and documentation collected by the General Accounting Office help explain why access to airport facilities is crucial for understanding competition in the airline industry (3–5). This research identified enplaning–deplaning gates, which are necessary to provide service at an airport, as operating barriers that can limit access to airport facilities. In turn, these institutional barriers to entry in the airline industry were able to explain the hub premium and, more generally, high airline fares (4). Often, these critical facilities are leased on an exclusive-use basis, which gives the lessee the sole right to use those facilities. The General Accounting

Office documented that more than 85% of the gates leased at the largest 66 airports were leased on such terms (5). The remaining 15% of the gates were leased on a preferential basis, which gave the lessee first right to use the facilities but made the gates available to other airlines when not in use by the lessee. Therefore, when an airline desired to begin service at an airport, often its only option was to sublease the gates and other facilities from an incumbent, a condition that can increase the cost to the new entrant and result in limited entry and less-intense competition.

Ciliberto and Williams collected original data from competition plans that airports were required to submit to the U.S. Department of Transportation in compliance with the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR-21); these data showed that the control of gates leased on an exclusive basis by an airline was a crucial determinant of the hub premium (6). Similarly, limits on fees that airlines can charge for subleasing their gates lowered the prices charged by airlines. Finally, Ciliberto and Williams found that the control of gates and limits on sublease fees explained high fares only when gates were scarce relative to the number of departures out of or arrivals into an airport (6). Snider and Williams exploited a discontinuity in the coverage cutoffs for treatment under AIR-21 to show that consumers experienced substantial gains, in the form of lower fares, when airports were forced to increase access to airport infrastructure and to eliminate other operating barriers to entry (2).

In related and more recent work, Williams expanded the data in Ciliberto and Williams well beyond those available in the competition plans. Specifically, Williams partnered with the Airport Council International—North America to survey airports to collect similar data to those in the competition plans from airports for 1997, 2001, 2007, 2008, and 2009. For the top 150 airports, the response rate exceeded 60% (1). Ciliberto and Williams used these data to develop equilibrium models to explain pricing dynamics in the industry (6). Despite these contributions, much remains to be learned about the role that airline–airport contractual agreements have in determining the level and distribution of surplus in airline markets, especially after the intense consolidation from 2008 to 2015.

INSTITUTIONAL DETAILS

A number of horizontal mergers have occurred in the airline industry in the last 10 years. The first of the three most recent large-scale mergers was between DL and NW on December 31, 2009, which was followed by the CO–UA and AA–US mergers. DL and NW became a single operating entity on January 31, 2010. At the time, this merger resulted in DL’s becoming the largest domestic carrier. It also resulted in a massive restructuring of DL’s network. Following the acquisition of NW, DL dramatically expanded operations in Detroit and Minneapolis, both former NW hubs. Simultaneously, DL eliminated its Cincinnati hub and reduced flights from Salt Lake City by 40%. These changes resulted in three extremely concentrated hub airports at which DL was responsible for more than 60% of the enplanements alone and controlled the vast majority of airport facilities. At both Minneapolis and Detroit, DL had exclusive leases on more than 50% of the boarding gates, which permitted them to exclude competitors from using these facilities, even when the gates were not in use for long periods. This concentrated and exclusive control of airport facilities resulting from the merger drew substantial antitrust attention, yet little was done to force concessions from the newly formed DL.

Another substantial driver for the growing concentration at numerous U.S. airports has been the dramatic growth of WN. Because of the nature of WN’s operations, point-to-point rather than hub-and-spoke flights are much more evenly dispersed across the airports at which WN operates. Yet, over time, the concentration levels at the airports at which WN conducts the majority of its flights [e.g., Chicago Midway International, Dallas Love Field, Baltimore–Washington International Thurgood Marshall, and McCarran International] have become much higher (i.e., Herfindahl–Hirschman Index levels well above those of the largest “fortress” hubs of legacy carriers). In addition, WN further increased its concentration levels at many airports through its acquisition of AirTran.

Concurrently with the rapid consolidation of airlines, DOJ forced some merged airlines to divest assets, as was the case in the AA–US merger. Specifically, according to a release from November 12, 2013 by DOJ,

[t]he settlement requires the companies to divest or transfer to low cost carrier purchasers approved by the department:

All 104 carrier slots (i.e., slots not reserved for use only by smaller, commuter planes) at Reagan National . . .
Thirty-four slots at LaGuardia . . .
Rights and interests to two airport gates and associated ground facilities at each of Boston Logan, Chicago O’Hare, Dallas Love Field, Los Angeles International and Miami International. (7)

Thus far, slots at Reagan National were divested to WN, Jet Blue, and Virgin America. At LaGuardia, slots were divested to WN and Virgin America.

The consolidation has also sparked concerns and allegations that the three remaining legacy carriers (DL, UA, and AA) and WN had colluded to restrict seating capacity and to raise fares. As a result, DOJ has an ongoing investigation into such practices and has requested all communications between the airlines that discuss capacity and pricing strategies. Given the current level of antitrust scrutiny and concerns over abuses of market power in the airline industry, DOJ must gain a greater understanding of the role that airline–airport agreements have in facilitating greater competition, which can serve to limit collusive practices and abuses. The way that airline–airport agreements affect airline competition is a potentially crucial question because reallocating gates has been one of the main solutions that DOJ has adopted to address the potential anticompetitive effects of mergers. The DOJ release cited above also stated,

The Department of Justice today announced that it is requiring US Airways Group Inc. and AA’s parent corporation, AMR Corp. to divest slots and gates at key constrained airports across the country to low cost carrier airlines (LCCs) in order to enhance system-wide competition in the airline industry resulting in more choices and more competitive airfares for consumers. (7)

The new data allowed investigation of this solution in much more detail than previously done.

DATA

Data from several sources were combined. The key data concerned the type of access that airlines had at U.S. airports, information collected through an original survey (discussed in detail later). These data were combined with information collected earlier and used in previous research (1, 2, 6). These data on the nature of the access of airlines to airports were merged with data from both the T-100

Domestic Segment of (Air Carrier Statistics) Form 41 reported by the Bureau of Transportation Statistics and the bureau's Origin and Destination Survey (DB1B), which is a 10% sample of airline tickets sold by airlines in a quarter.

Data on Access to Airport Facilities

Detailed current and historical information was collected on the type of access that airlines have at U.S. airports. Similar information must be reported under AIR-21 by major airports. (AIR-21 was signed into law in April 2000. It stated that, beginning in FY 2001, no federal grant would be made to fund any one of a set of major airports unless it provided detailed information on the availability of airport gates, leasing and subleasing arrangements, gate use requirements, gate assignment policies, etc.) However, the information is not published regularly, and few airports are required to report. (Only commercial airports with both more than 0.25% of the total number of passenger boardings each year in the United States and one or two air carriers controlling more than 50% of the passenger boardings are required to publish this information in competition plans.) The authors plan to collect information on an annual basis from all U.S. airports that belong to the Airport Council International—North America, which represents nearly all top-200 airports in number of enplanements.

The authors developed a preliminary version of an online portal that is being used to solicit retrospective information from airports as well as to conduct their survey more easily in the future. The new data set permits a greater understanding of the role of airline-airport agreements in determining the level of competition and possibly the incidence of any collusive activities among airlines or abuses of market power, and how these relationships have changed over time. More specifically, the collected data include the number of exclusive and preferential gates by carrier, information on whether the airport allows for subleasing of gates and on terms of any sublease agreements, and the existence and terms of majority-in-interest agreements.

Carriers, Markets, and Routes

This study considered 83 national carriers between 1993 and 2014 and focused on the following carriers: AA, CO, DL, HP, NW, Trans World Airlines (until the second quarter 2001), UA, US, and WN. Carriers were denoted by j and time was denoted by $t = 1, 2, \dots, T$.

Airlines that merged between 1997 and 2013 were identified: 15 carriers were involved in 10 mergers during the sample period:

- AirTran and ValuJet (FLJ7) (1997),
- AA and Reno (AAQQ) (1999),
- AA and Trans World Airlines (AATW) (2001),
- US and HP (USHP) (2006),
- DL and NW (DLNW) (2008),
- WN and AirTran (WNFL) (2010),
- CO and UA (COUA) (2010),
- Frontier and Midwest (F9YX) (2010),
- DL and Endeavor (DL9E) (2013), and
- AA and US (AAUS) (2013).

When the effect of divestiture on gates was considered, the unit of observation was a carrier-airport-year. For example, the combina-

tion jst indicates that airline j (e.g., AA) leases or subleases gates at airport s (e.g., Chicago O'Hare) at time t (e.g., 2009).

A market (m) was defined as an airport-to-airport trip, irrespective of the number of connections. When the effect of divestiture on fares was considered, the unit of observation was a carrier-market-year-quarter. For example, the combination jmt indicates that airline j transports its passengers in market m (e.g., Chicago O'Hare to Fort Lauderdale Airport) at time t (e.g., second quarter 2002).

Merger and Divestiture Variables

The set of N mergers was defined as $\Omega = \{\text{FLJ7, AAQQ, AATW, USHP, DLNW, WNFL, COUA, F9YX, DL9E, AAUS}\}$. Subscript n ($n = 1, 2, \dots, N$) denoted the merger of interest ($N = 10$). A distinction was made between the effect that mergers and divestitures had on prices and on the access to airport facilities of merging parties and their competitors. To do so, Merge_{mt} was first defined equal to one if either of two merged firms at time t provided service in market m ; otherwise, Merge_{mt} was equal to zero. To differentiate airports and routes affected by divestiture, Divest_{mt} was set equal to 1 if $\text{Merge}_{mt} = 1$ in that market and DOJ had forced divestiture at one of the endpoints of market m . Specifically, the divestitures examined were those required in the AA-US and the CO-UA mergers. The numbers of gates before and after the mergers were reported, grouped by merging carrier, nonmerging LCC, and nonmerging other (Table 1).

TABLE 1 Gate Access at Airports with Forced Divestiture After Mergers

Airport	Airline Type	Number of Gates		Percentage of Gates	
		Before Merger	After Merger	Before Merger	After Merger
AA-US Merger					
BOS ^a	Merging	32	28	36	36
BOS	Nonmerging LCC	7	26	8	34
BOS	Nonmerging other	51	23	57	30
DCA	Merging	20	19	45	42
DCA	Nonmerging LCC	3	11	7	24
DCA	Nonmerging other	21	16	48	34
LGA	Merging	33	17	47	25
LGA	Nonmerging LCC	1	4	1	6
LGA	Nonmerging other	56	47	51	59
CO-UA Merger					
EWR	Merging	55	43	63	39
EWR	Nonmerging LCC	0	5	0	5
EWR	Nonmerging other	33	63	38	57
Average Across Airport Types					
na	Merging	35	27	48	35
	Nonmerging LCC	3	12	4	17
	Nonmerging other	35	37	48	47

NOTE: BOS = Logan International Airport; DCA = Ronald Reagan Washington National Airport; EWR = Newark Liberty International Airport; LGA = LaGuardia Airport; na = not applicable.

^aThe changes that occurred in Boston at the time were not necessarily a direct result of the merger and forced divestiture. The table is descriptive and does not claim that the mergers were causal in the changes in gates.

Other Control Variables

To control for other characteristics that affect gate access and fares, several other variables were created. First, to address the possibility that a carrier's existence in a market can affect the behavior of other carriers in that market, regardless of whether that carrier was involved in a merger, InMarket_{jmt} is a set of indicators for each merging carrier's presence in the market. Second, a control for bankruptcy was also created. The terms InBkrpcy_j and AnyBkrpcy_{jmt} are, respectively, indicators for whether carrier j is bankrupt and whether any of the other carriers in market m are bankrupt at time t . Last, the authors created the indicator AIR-21_{mt} , which equals 1 if, at time t , airport m is affected by AIR-21, legislation that should increase competition and lower fares at airport m .

ECONOMETRIC SPECIFICATIONS

The empirical approach used here closely follows the approach in Ciliberto and Schenone, who investigated the effect of bankruptcy on prices, capacity, and quality, measured in relation to delays, cancellations, and age of a fleet (8, 9).

Two main relationships were estimated. First, the effect of mergers on access to gates was examined, particularly in airports where DOJ forced divestiture of gates by the merging carriers. That the data showed evidence of the forced divestiture implemented by DOJ was verified. Second, the effect of this forced divestiture on average fares was investigated.

The identification concerns are the same as in Ciliberto and Schenone (8, 9). Specifically, seasonal or exogenous shocks might generate price changes that can confound the effects of mergers and divestitures on gates and prices. Time-fixed effects were included to control for these confounding factors. Next, some route and carrier-specific unobservable conditions might be constant over time and affect the pricing decisions of firms as well as their decisions about the number of gates at the airports they serve. To control for these sources of unobservable time-invariant heterogeneity, market fixed effects were included.

Furthermore, the presence of a carrier in a market can have an effect on the behavior of other carriers in that market, regardless of whether the carrier is one of the merging parties. The categorical variable InMarket_{mt} was included to identify the effect of a merger. The variable InMarket_{mt} is equal to one when either of the two merging carriers is in market m at time t , where a market is an airport-to-airport trip.

First, the study looked for a relationship between airports at which DOJ forced divestiture and access to gates (gates_{jst}) by airlines. The observation here was at the carrier-airport-year level. The effects of a merger were allowed to differ by type of carrier k , where the types were merging carrier, nonmerging legacy carrier, WN, and other LCC.

The following equation was estimated:

$$\text{gates}_{jst} = \sum_k \alpha_k \text{Divest}_{st} \times 1_{j \text{ is type } k} + \sum_k \beta_k \text{Merge}_{st} \times 1_{j \text{ is type } k} + \epsilon_{jst} \quad (1)$$

where

$$\begin{aligned} \epsilon_{jst} &= \text{other controls and fixed assets} \\ &= \text{InMarket}_{jst} \lambda + \gamma_1 \text{InBkrpcy}_{jst} + \gamma_2 \text{AnyBkrpcy}_{jst} \\ &\quad + \gamma_3 \text{AIR-21}_{st} + e_j + e_s + e_t + e_{jst} \end{aligned} \quad (2)$$

and

- α_k = parameters that estimate effect of divestiture for carrier type k ,
- λ = vector of estimated parameters on effect of being part of market with one carrier in a merger,
- γ = estimated parameters on controls,
- e_j = carrier fixed effect,
- e_s = market fixed effect,
- e_t = year fixed effect, and
- e_{jst} = idiosyncratic shock.

Data were restricted to airports for which information on gates was available and resulted in 8,074 observations. The results from this regression are reported in Table 2 and discussed in the section on results.

After investigation of how mergers affect gate access, the next step was to examine the effect of the merger and forced divestiture on average fares. The observation was now at the carrier-market-year-quarter level. The effects of divestiture were allowed to differ by either of two types of carrier, h : merging and nonmerging. The effect of the merger was allowed to differ by type of carrier type l and by merger n , of which three types are considered: merging, nonmerging, and LCC. Specifically, the data on gate access were combined with DBIB data on fares, and the following baseline specification for the average fare (avgfare_{jmt}) for carrier j flying in market m at time t was estimated:

$$\begin{aligned} \log(\text{avgfare}_{jmt}) &= \sum_h \delta_h \text{Divest}_{mt} \times 1_{j \text{ is type } h} + \sum_l \theta_l^n \text{Merge}_{mt} \\ &\quad \times 1_{j \text{ is type } l} + u_{jmt} \end{aligned} \quad (3)$$

where

$$\begin{aligned} u_{jmt} &= \text{InMarket}_{jmt} \omega + \rho_1 \text{InBkrpcy}_{jmt} + \rho_2 \text{AnyBkrpcy}_{jmt} \\ &\quad + \rho_3 \text{PctOriginPres}_{jmt} + \rho_4 \text{AIR-21}_{mt} + \mu_j + \mu_m + \mu_t + \mu_{jmt} \end{aligned} \quad (4)$$

and

- δ_h = parameter estimating effect of divestiture on $\log(\text{avgfare})$,
- θ_l^n = estimate of marginal effect of merger on average fares caused by merger n on type l ,
- ρ_x = parameters estimating effects of controls,
- ω = set of mergers,
- $\text{PctOriginPres}_{jmt}$ = percentage of customers on carrier j flying from origin of market m at time t (helps to capture power of carrier j in that market),
- μ_j = carrier fixed effect,
- μ_m = market fixed effect,
- μ_t = year-quarter fixed effect, and
- μ_{jmt} = idiosyncratic shock.

The specification in Equation 3 is analogous to that in Equation 1, except with the addition of possible heterogeneous effects of mergers by a merger. The baseline specification provides no allowance for heterogeneity and restricts $\theta_l^n = \theta_l$, and the effect of any merger is the same for each type.

After small markets (fewer than 1,000 passengers served in a quarter) and small carriers (fewer than 100 passengers served in a quarter) were dropped, 2.8 million observations remained. Table 3 uses three specifications. Column 1 uses a specification examining the effects of mergers on fares; Column 2 adds the average effect of

TABLE 2 Effect of Mergers on Gate Access

Variable	log(Gates) (1)	Gates (%) (2)	Number of Gates (3)
DOJ-forced divestiture			
× merging carriers	-0.481*** (0.106)	-0.066*** (0.014)	-0.310*** (0.086)
× legacy carriers	-0.087 (0.099)	-0.040*** (0.012)	-0.403*** (0.128)
× WN	0.345 (0.218)	0.053*** (0.020)	2.262*** (0.341)
× other low-cost carriers	0.038 (0.156)	0.029** (0.012)	1.308*** (0.170)
Effect of merger on merging airlines	0.013 (0.022)	-0.002 (0.002)	-0.076** (0.031)
Effect of merger on nonmerging legacy carriers	-0.019 (0.028)	-0.008*** (0.003)	-0.042 (0.037)
Effect of merger on WN	0.116 (0.073)	0.010 (0.007)	0.187* (0.108)
Effect of merger on other LCCs	0.150*** (0.053)	0.002 (0.003)	0.912*** (0.127)
Number of observations	3,747	8,074	8,074
Adjusted R^2	.900	.810	

NOTE: Standard error in parentheses.
* $p < .1$; ** $p < .05$; *** $p < .01$.

divestiture; and Column 3 allows divestiture to have separate effects on different types of carriers. Table 4 restricts the sample to the five most recent mergers and allows them to have heterogeneous effects on fares. The results from these regressions and Tables 3 and 4 are discussed in the following section.

RESULTS

This section reports the results of the regressions specified in the section on econometric specifications and includes three sets of results. Table 2 reports the effect of divestiture on gate access. Tables 3 and 4 report the results of divestiture on average fares.

Effect of Divestiture on Gate Access

Table 2 shows the effect of divestiture on gate access. Column 1 uses the log of the number of gates as the dependent variable. Because the calculations include an airport fixed effect, a carrier fixed effect, a year fixed effect, and indicators for each merger that has occurred, the effect of divestiture on merging carriers' access to gates is identified by the additional or reduced access at the specific airports where divestiture is required relative to the additional or reduced access that may have occurred in general across all airports. For the merging carriers, the effect of divestiture seems to be decreased gate access by 48% relative to airports where divestiture was not required. However, this percentage should be taken with a grain of

TABLE 3 Effect of Divestiture on Fares

Variable	Log of Average Fare		
	(1)	(2)	(3)
DOJ-forced divestiture		-0.015*** (0.001)	
× merging carriers			-0.028*** (0.002)
× nonmerging carriers			-0.009*** (0.002)
Effect of merger on merging carriers	-0.035*** (0.001)	-0.035*** (0.001)	-0.035*** (0.001)
Effect of merger on nonmerging legacy carriers	-0.043*** (0.001)	-0.043*** (0.001)	-0.044*** (0.001)
Effect of merger on LCCs	0.130*** (0.001)	0.130*** (0.001)	0.130*** (0.001)
Number of observations	2,848,266	2,848,266	2,848,266
Adjusted R^2	.202	.202	.202

NOTE: Standard error in parentheses.
* $p < .1$; ** $p < .05$; *** $p < .01$.

TABLE 4 Effect of Divestiture on Fares with Allowance for Heterogeneity in Mergers

Variable	Log of Average Fare		
	(1)	(2)	(3)
DOJ-forced divestiture		0.001 (0.001)	
× merging carriers			-0.005** (0.003)
× nonmerging carriers			0.003* (0.002)
Effect of mergers on merging carriers			
US-HP	0.061*** (0.001)	0.061*** (0.001)	0.061*** (0.001)
DL-NW	-0.082*** (0.001)	-0.082*** (0.001)	-0.082*** (0.001)
WN-FL	0.150*** (0.002)	0.150*** (0.002)	0.150*** (0.002)
AA-US	-0.041*** (0.002)	-0.041*** (0.002)	-0.039*** (0.002)
CO-UA	-0.056*** (0.002)	-0.056*** (0.002)	-0.056*** (0.002)
Effect of mergers on nonmerging legacy carriers			
US-HP	-0.004*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)
DL-NW	-0.020*** (0.001)	-0.020*** (0.001)	-0.020*** (0.001)
WN-FL	0.135*** (0.001)	0.135*** (0.001)	0.135*** (0.001)
AA-US	-0.025*** (0.002)	-0.025*** (0.002)	-0.025*** (0.002)
CO-UA	0.008*** (0.001)	0.008*** (0.001)	0.008*** (0.001)
Effect of mergers on LCCs			
US-HP	0.034*** (0.001)	0.034*** (0.001)	0.034*** (0.001)
DL-NW	0.044*** (0.002)	0.044*** (0.002)	0.044*** (0.002)
AA-US	-0.039*** (0.002)	-0.039*** (0.002)	-0.039*** (0.002)
CO-UA	-0.042*** (0.002)	-0.042*** (0.002)	-0.042*** (0.002)
Number of observations	2,848,266	2,848,266	2,848,266
Adjusted R ²	.197	.197	.197

NOTE: Standard error in parentheses.

* $p < .1$; ** $p < .05$; *** $p < .01$.

salt; because the log of gates as the dependent variable was used, all carriers with zero gates were dropped from this specification. This drawback was remedied in the second and third specifications.

In the first specification, the effect of divestiture on the other carriers besides the merging carriers is unclear. The only other significant finding is that the effect of the merger in general was to increase LCCs' access to gates across all airports by 15%.

The second column of Table 2 shows estimates of a linear probability model and uses the percentage of gate access at an airport as the dependent variable. In this regression, the effect of divestiture on the different types of carriers is much clearer. In airports where divestiture was required, merging carriers lost 6% of their gates and other legacy carriers lost 4% of their gates. These were gained by WN and the other LCCs, with WN increasing gate access by 5.3% and other LCCs by 2.9%.

The third column in Table 2 shows estimates of a Poisson regression, for which the dependent variable is the number of gates accessible to a carrier at a specific airport. These results echo the results from the second specification. Relative to airports where divestiture was not required, merging carriers lost 0.3 gate and nonmerging legacy carriers 0.4 gate. These losses were transferred to WN and the other LCCs. On average, WN gained 2.3 gates and other LCCs 1.3 gates.

Effect of Divestiture on Fares

Tables 3 and 4 show the effects of divestiture on fares. Table 3 reports the baseline results, with an average effect of mergers on fares being estimated. Table 4 disentangles the average effect and allows for heterogeneous effects across five mergers.

In the baseline specifications presented in Table 3, Column 1 shows that the effect of mergers on the fares of both merging carriers and nonmerging legacy carriers was negative, decreasing the merging carriers' average fare by 3.5% and the nonmerging legacy carriers' average fare by 4.3%. (This result is counterintuitive. One possible explanation for the decreasing fares is a cost saving for the newly formed airline. This question is left to future research.) In contrast, the effect of a merger on the fares of nonmerging LCCs was positive and significant, with fares increasing by 13% after a merger by legacy carriers. Column 2 of Table 3 shows that divestiture, on average, lowered fares by 1.5% for all carriers relative to markets having no divestiture at either endpoint. Column 3 of Table 3 shows that, when this effect is spread over the merging and nonmerging carriers, although fares for both types of carriers fell, the effect on merging carriers was greater. The merging carriers' fares fell by 2.8%, while the nonmerging carriers' fares fell by about 1%.

Table 4 restricts the merger analysis to five major mergers between 2005 and 2015 and allows for these mergers to have heterogeneous effects. (The five mergers were US and HP, DL and NW, WN and AirTran, AA and US, and UA and CO). The results showed two striking differences relative to the previous results. First, the effect of divestiture was much smaller. The average effect was not significant, and when the effects were estimated separately for merging and nonmerging carriers, they were found to be very small. For merging carriers, the effect of divestiture was to lower fares by only 0.5%, and for nonmerging carriers, the effect of divestiture was actually an increase in prices by 0.3%. Second, the effect of mergers on merging airlines' fares was positive when a low-cost carrier was involved in the merger, and it was negative when the merging carriers were only legacy carriers. For example, the effect of the US-HP merger increased the merging carriers' average fares by 6.1%, while the merger between AA and US decreased the merging carriers' fares by 4.1%. One possible story here is that mergers between legacy carriers induce cost savings, and fares for the merging carriers fall as a result. Similarly, costs are already so low for low-cost carriers that any merger involving a low-cost carrier leads to an increase in fares by the merging parties.

CONCLUSION

This paper investigated the relationship between mergers, limited access to airport facilities, forced divestitures, and fares. A novel data set on airlines' leasing terms was collected for gates at major U.S. airports from 1996 to 2016. These data were used to estimate a relationship between (a) forced divestiture and gate access and (b) force divestiture and fares.

The data show evidence that divested gates were transferred to LCCs and that divestiture was apparently an effective technique in decreasing fares for both merging airlines (3% decrease) and non-merging ones (1% decrease) at affected airports relative to nonaffected airports. The authors' future work will include an analysis on the formation of airline networks by using variations across time, airports, and airlines. The authors are confident that they will be able to make major progress in studying the process airlines use to build their networks; such progress would be a major step beyond the standard-entry literature that models the entry decision at the route level and takes the network as given.

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REFERENCES

1. Ciliberto, F., and J. W. Williams. Limited Access to Airport Facilities and Market Power in the Airline Industry. *Journal of Law and Economics*, Vol. 53, No. 3, 2010, pp. 467–495. <http://dx.doi.org/10.1086/605725>.
2. Snider, C., and J. W. Williams. Barriers to Entry in the Airline Industry: A Multi-Dimensional Regression-Discontinuity Analysis of AIR-21. *Review of Economics and Statistics*, Vol. 97, No. 5, 2015, pp. 1002–1022. http://dx.doi.org/10.1162/REST_a_00455.
3. Berry, S. T. Estimation of a Model of Entry in the Airline Industry. *Econometrica*, Vol. 60, No. 4, 1992, pp. 889–917. <http://dx.doi.org/10.2307/2951571>.
4. Borenstein, S. Hubs and High Fares: Dominance and Market Power in the U.S. Airline Industry. *Rand Journal of Economics*, Vol. 20, No. 3, 1989, pp. 344–365. <http://dx.doi.org/10.2307/2555575>.
5. *Airline Competition: Industry Operating and Marketing Practices Limit Market Entry*. RCED-90-147. General Accounting Office, 1990.
6. Ciliberto, F., and J. W. Williams. Does Multimarket Contact Facilitate Tacit Collusion? Inference on Conduct Parameters in the Airline Industry. *Rand Journal of Economics*, Vol. 45, No. 4, 2014, pp. 764–791. <http://dx.doi.org/10.1111/1756-2171.12070>.
7. Justice Department Requires US Airways and American Airlines to Divest Facilities at Seven Key Airports to Enhance System-Wide Competition and Settle Merger Challenge. *Justice News*, Office of Public Affairs, Department of Justice, Nov. 12., 2013.
8. Ciliberto, F., and C. Schenone. Are the Bankrupt Skies the Friendliest? *Journal of Corporate Finance*, Vol. 18, No. 5, 2012, pp. 1217–1231. <http://dx.doi.org/10.1016/j.jcorpfin.2012.07.005>.
9. Ciliberto, F., and C. Schenone. Bankruptcy and Product–Market Competition: Evidence from the Airline Industry. *International Journal of Industrial Organization*, Vol. 30, No. 6, 2012, pp. 564–577. <http://dx.doi.org/10.1016/j.ijindorg.2012.06.004>.

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