# Competitive Effects of Regional Airline Exit: Evidence from the COVID-19 Pandemic

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**Abstract**

We examine the competitive effects of regional airline exits on the U.S. airline industry, leveraging the COVID-19 pandemic as a natural experiment. Using propensity score matching and difference-in-differences strategies, we find that consumers are worse off, on average. When regional airlines exit, there is a significant decrease in both market flights and capacity, with no immediate replacements. Additionally, market airfare rises by roughly 3.7%. Further, at the airline level, incumbent carriers increase flights and capacity by 11.7% and 12.2%, respectively. Low-cost and smaller carriers, in particular, capture more markets but offer worse on-time performance and higher prices. In summary, our findings reveal the multifaceted nature of competition dynamics in the airline industry, providing insights for the design of effective regulatory and competitive policies to benefit consumers.

Keywords: Air Transportation, Exit, Market Structure, Competition, COVID-19
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# 1 Introduction

Policymakers in the U.S. have expressed concern about the growing concentration in various industries that would harm consumers (Council of Economic Advisers, 2016). The airline industry is not an exception to this increasing trend of concentration, especially after the recent merger wave including Delta-Northwest in 2008, United-Continental in 2010, Southwest-AirTran in 2011, and American-US Airways in 2014.[1] Importantly, the impacts of industry consolidation do not impose equally across places. Small communities may feel the adverse impacts of industry consolidation more because they have already faced limited air service (Regional Airline Association, 2019). It is imperative to understand how growing concentration in the airline industry would affect the consumers in those smaller communities.

Regional airlines have been playing a pivotal role in connecting small communities to the air transportation network (Regional Airlines Association, 2023). About two-thirds of US airports with scheduled passenger service rely exclusively on regional airlines. Although regional airlines have a cost advantage in operating small aircraft (Forbes and Lederman, 2009), they are more vulnerable to bankruptcy (Budd et al., 2014). During the COVID-19 pandemic, travel restrictions halted most air travel together. Consequently, a few regional airlines ceased operations, starting with the bankruptcy announcement of Trans States Airline in February 2020. Regional airlines' exits during the COVID-19 pandemic provide a quasi-experiment of increased concentration in the airline markets that serve small communities.

The competitive effects of airline exit on frequency, capacity, quality provision, and pricing are estimated using a difference-in-differences (DiD) model, where we define the market as a non-directional city pair. The markets with regional airline exits consist of the treatment group, while the other markets are designated as the control group. Since markets with a regional airline exit might not be selected randomly, we employ the propensity score matching method to construct a control group of markets without exit that controls the selection issue with observables. Then, we employ DiD methods with airline-market-specific

[1] In fact, the market concentration in the U.S. airline industry became more concentrated than the European airline industry but their concentrations were similar in the 1990s (Gutiérrez and Philippon, 2018).

fixed effects to control the observed and unobserved heterogeneities at the airline-market level.

Our empirical analysis is based on several datasets covering the United States during the period from April 2019 to December 2020. Using OAG data, we collect daily flight schedules in each market for the period from April 2019 to December 2020. In particular, we observe the number of flights and capacity operated by each airline in each market. From that information, we aggregate the daily number of flights (capacity) into monthly to construct the frequency (capacity) variable. Furthermore, we collect information on airline ticket prices, arrival delays, employment, and financial data from the Bureau of Transportation Statistics (BTS). The analysis of frequency, capacity, and delay is at the airline-market-month level and the analysis of prices is at the airline-market-quarter level.

Our analysis leads to the following conclusions. First, market frequency and capacity decrease significantly by around 22.1% and 17.1%, respectively, after a regional airline exits. In other words, there is no entry right after the exit of a regional airline. The airfare (on-time performance) of the markets experiencing airline exit increases by about 3.7% (decrease by about 21.2%) on average compared to those of the markets without any regional airline exit. Furthermore, we conduct an event study to show that there are no pre-trends in frequency, capacity, arrival delays, and pricing for the markets with a regional airline exit relative to those for the markets without exit. Second, our event study results show that although market on-time performance improves shortly after regional airlines' exit, it returns to the original level at the end. At the same time, the market fares exhibit a significant increase post-exit and stabilize at a higher level compared to the pre-exit period. Overall, our results suggest that consumers are worse off after an airline exit. Finally, we examine the responses of incumbent airlines after a regional airline exits the market and explore the heterogeneities in our results. We find that incumbent airlines increase their markets by around 12%, reduce their arrival delays by 19.2%, and offer higher prices by 3.1% after the exit of a regional airline. Specifically, low-cost and smaller airlines capture more market shares from the exiting airlines. However, at the same time, they provide worse on-time performance and higher prices. This is because low-cost and smaller carriers are the main competitors before the regional airlines exit. Therefore, when their competitors exit the market, they face less competition, which results in worse quality services and higher prices. Similarly, carriers with substantial cash reserves also charge higher prices, given their financial capacity to operate in the market. In contrast, worse on-time performance airlines provide better quality services by reducing arrival delays and lower prices.

Our paper contributes to two strands of literature. First, it adds to a growing empirical literature that looks into the competitive effects of airline exit in the U.S.[2] Daraban and Fournier (2008) examine the exit of LCCs during 1993-2006 and find that the average market price increases after a LCC exits, but remains about the same after Southwest exits. Bachwich and Wittman (2015) examine the exit of LCCs during 2010-2015 and find that the remaining airlines increase prices by about 10% after the exit. In a closer relationship to work, Hüschelrath and Müller (2013) examine the exit of five airlines due to filing Chapter 7 bankruptcy during 1995-2010, and find that the remaining airlines increase prices by 12% and decreases passengers service by 15% after the exit.

Our work also examines the airline exit due to filing Chapter 7 bankruptcy but extends the previous work in several aspects. First, airline exit can be a response to incumbent strategies, such as price war and capacity expansion, which potentially exaggerate the price increase and frequency decrease after airline exits. In contrast, we employ the airline exits during the COVID-19 pandemic, which serves as an exogenous shock to airline exits and provides more credible competitive effects of airline exits. Second, we investigate the redistribution of market share from the exits of airlines to the remaining airlines and explore the determinants that drive the redistribution. Third, we do not only focus on prices and demand but also examine the competitive effect of airline exits on service quality. Lastly, we delve into the heterogeneity of airlines, specifically examining how different incumbent airlines respond to exits in terms of their frequency, capacity, service quality, and pricing.

[2] There is also a literature exploring the competitive effects of airline exit in European markets. Bilotkach et al. (2014) examine the exit of MALEV in 2012 and find mixed impacts on consumers because the replacing LCC, WizzAir, charges a lower price than MALEV but service with a lower flight frequency. Fageda et al. (2017) examine the exit of Spanair in 2011 and suggest that consumers benefit from it because the LCC entrants lower market prices and keep flight frequency about the same. Grosche et al. (2020) examine the exit of Air Berlin in 2017 and find that most markets become more concentrated. Eugrnio-Martin and Parez-Granja (2022) examine the exit of charter airline Monarch and Thomas Cook and find that the remaining airlines did not pick up the lost passengers between the U.K. and the Canary Islands after the exit of Monarch but pick up a part of lost passengers after the exit Thomas Cook.

Second, it contributes to the literature that examines the implications of airline competition during the COVID-19 pandemic. Abate et al. (2020) argue that governments across the world attempt to maintain air transport connectivity in order to protect economic activities. Larger airlines would benefit from supporting policies, while smaller airlines might exit the market. Indeed, there are country-level evidence showing that large airline benefits during the COVID-19 pandemic. Albers and Rundshagen (2020) suggest the bailout of Alitalia during the COVID-19 pandemic may distort competition and Ng. et al. (2023) document the top two Japanese airlines secured a higher market share after the COVID-19 pandemic. In a closer relationship to our work, Mumbower (2022) finds that exit probability increases after COVID-19 but varies across small and large markets, and legacy and low-cost airlines. Although the previous works indicate that travelers face a more concentrated market after the COVID-19 pandemic, there is no discussion on how such a change in market structure affects consumers. Our work extends the literature by examining the competitive effects on price, flight frequency, and service quality of airline exits in the U.S. during the COVID-19 pandemic. Our results are more relevant to inform how consumers are adversely affected by airline exits.

The outline of the paper is as follows. We introduce background and data in Section 2 and the empirical strategy in Section 3. Section 4 reports the main results. Section 5 concludes.

# 2 Background and Data Description

## 2.1 Airline Exits during the COVID-19 Pandemic

The COVID-19 pandemic had a profound impact on the airline industry in the United States. Many airlines in the United States faced significant challenges and financial difficulties, including travel restrictions, reduced demand for flights, and concerns about passenger safety. Several airlines took various measures in response to these challenges, including route reductions, furloughs, and retirements of older aircraft. Some airlines also exited certain markets, either ceasing operations temporarily or exiting the market permanently.

Table 1 documents that Trans State Airlines was the first to cease operations and declared bankruptcy on April 1, 2020, within the United States aviation sector. Subsequently, Compass Airlines followed suit, declaring bankruptcy and suspending operations on April 5, 2020. Although Ravn Air Group did not opt for a complete market exit, it opted to file for Chapter 11 bankruptcy to undertake debt restructuring. On August 22, 2020, ExpressJet Airlines initiated Chapter 11 bankruptcy proceedings, which resulted in a shift in ownership and its subsequent incorporation into SkyWest Airlines, where it began operating under the United Express brand. In contrast, Miami Air International's attempts to follow a similar path were unsuccessful, leading to the permanent cessation of its operations on May 8, 2020.[3][4]

In this paper, we only focus on Chapter 7 bankruptcy as in a Chapter 11 bankruptcy, the company continues to operate and restructures under the supervision of a court-appointed trustee, to emerge from bankruptcy as a viable business.

Table 1: Liquidation of U.S. airlines during COVID-19

| Airline | IATA code | Date | Bankruptcy Type |
|---|---|---|---|
| Trans State Airlines | AX | 2020-4-1 | Chapter 7 |
| Compass Airlines | CP | 2020-4-5 | Chapter 7 |
| Ravn Air Group | 7H/KS | 2020-4-5 | Chapter 11 |
| (RavnAir Alaska/PenAir) | | | |
| Express Jet | EV | 2020-8-22 | Chapter 11 |
| Miami Air International | LL | 2020-3-24 | Chapter 11 |
| | | 2020-5-8 | Chapter 7 |

Note: We report the name of the exit airlines, the IATA code of the exit airlines, the exit date, and the type of bankruptcy. In Chapter 7, the airline ceases operations, and a trustee sells all of its assets and then distributes the proceeds to its creditors. Any residual amount is returned to the owners of the company. In Chapter 11, in most instances the debtor remains in control of its business operations as a debtor in possession, and is subject to the oversight and jurisdiction of the court.

[3]Our database OAG does not include flight schedule information on Miami Air International, so we exclude this airline exit in our estimation.

[4]We obtain the information on the U.S. airlines exit from Airlines for America (last access on September 27, 2023).

## 2.2 Data Sources and Variables

### 2.2.1 Market Definition and Frequency

We define a market as a city pair. In particular, we employ MSA as our measure of city.[5] When travelers choose to travel from one place to another, for example, because of a cost reason, they may choose one of the nearby (but not the nearest) airports as the origin and choose one of the nearby airports at their destination as the destination airport. An advantage of using MSA is that it includes multiple airports in the same MSA.[6]

The data on airline market frequency and capacity is collected from OAG Analyser, which contains information on domestic daily flight schedules in the United States. This database includes details such as the names of the operating flights, the departure and arrival airports, the scheduled departure and arrival times, the duration of flights, the number of stops, the number of flights, and the seating capacity for the period between 2019 and 2020.

We construct the airline market frequency by aggregating the number of flights operated by the airline in the market per month. For robustness check, we construct the airline market capacity by multiplying the number of flights and the number of seats on each flight. To obtain the market-level frequency and capacity, we take the sum of airline market frequency and capacity for each market in each month.

### 2.2.2 On-time Performance and Fare

The data on on-time performance is sourced from the Bureau of Transportation Statistics (BTS). This dataset includes information on scheduled and actual departure and arrival times. This data enables us to track delays in both departure and arrival for different carriers, in various markets, by month, and by year, as well as by origin and destination airports. To measure on-time performance, we rely on the minutes of arrival delays variable.[7] In particular, we calculate the average arrival delay, measured in minutes, for each carrier

[5] In the United States, a metropolitan statistical area (MSA) is a geographical region with a relatively high population density at its core (Census Bureau-defined Urban Area) and close economic ties throughout the region.

[6] To have more variations, for those cities that are not located in an MSA, we also include them as separate cities.

[7] We also use the minutes of departure delays to construct the on-time performance variable and we find similar results.

operating within each market during each month. This allows us to construct our variable for airline-market on-time performance. To determine market-level on-time performance, we take the average of the airline-market on-time performance data for each market in each month.

The ticket fare data comes from Airline Origin and Destination Survey (DB1B). This dataset contains the origin airport code, origin city, destination airport code, destination city, operating carrier, number of passengers, market fare, and market miles flown, with data reported quarterly. Given the quarterly nature of this dataset, we construct the airline-market fare variable by calculating the average ticket fares charged by each carrier for each market during each quarter. Additionally, the market fare variable is computed by averaging the airline-market fares for each market within the same quarterly timeframe.

We combine the three datasets—flight data, on-time performance data, and ticket fare data—by matching them using the origin and destination airport codes. This process allows us to identify the airports common to all three datasets and we can obtain the information about the respective city names where these airports are located.[8] Then, we transform the city names in the OAG database into the metropolitan statistical area (MSA) to construct the variables at the MSA level.[9][10]

### 2.2.3 Airline Characteristics

We collect the low-cost carrier information from the International Civil Aviation Organization (ICAO) which provides information on low-cost carriers (LCCs) all over the world based on ICAO definition. We can observe their regions, countries, names, ICAO code, IATA code, the beginning of operation, and if they ceased operation. [11] We only consider the U.S. airlines that are included in our data sample.

We also collect airline employment and financial data from the Bureau of Transportation

[8]We utilize the airport-city corresponding table provided by OAG.

[9]For the cities that are not located in any MSA, we keep their original names as in the OAG. We take the sum of the frequency and capacity and average of on-time performance and fare for each MSA.

[10]We utilize the core-based statistical area maps for each state in the United States, which are defined by the federal Office of Management and Budget (OMB). These maps are instrumental in helping us ascertain whether the cities listed in the OAG dataset are located within a Metropolitan Statistical Area (MSA).

[11]Link to the list of Low-Cost-Carriers (LCCs): https://www.icao.int/sustainability/documents/lcc-list.pdf.

Statistics (BTS). Specifically, the financial data comes from Air Carrier Financial Reports. The report contains quarterly operating balance sheet statements for large certificated U.S. air carriers with annual operating revenues of $20 million or more and includes balance sheet items such as cash. The number of employees data comes from the Air Carrier Employees Database which reports monthly full-time and part-time employment statistics of the airlines that operate at least one aircraft with the capacity to carry combined passengers, cargo, and fuel of 18,000 pounds(the payload factor).

Furthermore, we utilize the arrival delay data in the second quarter of 2019 as the incumbent airlines' on-time performance characteristic. We take the average of the minutes of arrival delay by incumbent airlines to get the on-time performance at the airline level.

The employment information is provided monthly while the cash variable is reported quarterly. To harmonize the data, we aggregate the monthly characteristics into quarterly. Furthermore, one of the characteristics we consider is the airline's on-time performance. Specifically, we use the second quarter of arrival delays for each carrier. To make these data more suitable for analysis, we apply a demeaning process to the carriers' employment, cash, and arrival delays.[12]

In the end, we combine the airline characteristics variables with airline-market frequency, capacity, on-time performance, and fare to explore the heterogeneous effects of regional airlines' exit. We use the airline's name as the common identifier and retain only those airlines that are present in both datasets.

## 2.3 Descriptive Statistics

Our data period is from April 2019 to December 2020.[13] Table 2 presents the descriptive statistics of the main variables in our estimation. At the market level, the incumbent airlines have approximately 104.6 frequency on average, which means that the average number of flights provided in a market is 104.6 per month. In terms of capacity, the mean value is about 12,406, implying that, on average, this number of passengers travel by air in a market

[12] We apply the demeaning process to remove the effect of systematic trends and reduce multicollinearity.

[13] The regional airlines exited in April 2020. To ensure comparability, we have chosen our data sample from April 2019.

each month. In addition, we observe that the average delay in a market per month is about 7 minutes and the mean fare charged in a market is roughly $182 quarterly.

At the airline-market level, the mean of the frequency and capacity are 101 and 12,706 respectively, which indicates that on average, each carrier operates 101 flights and carries 12,706 passengers in a market per month. Moreover, each carrier experiences an average monthly delay of approximately 7.7 minutes and charges around 182 dollars in each market per quarter.

Regarding the airline characteristics variables, LCC_carrier is a dummy variable. It takes 1 when an airline is an LCC, otherwise, it takes 0. We can observe that the mean of LCC_carrier is 0.333, which indicates that 33.3% carriers in our sample are low-cost carriers. Moreover, we can observe that on average, each incumbent airline has around 26,914 employees, holds approximately $506,405 in cash, and has 12.517 minutes in arrival delay.

Table 2: Summary Statistics

| Variables | Mean | SD | Min | Max | Observations |
|---|---|---|---|---|---|
| **Market Level Variables** | | | | | |
| frequency | 104.600 | 111.181 | 1 | 1,394.923 | 46,247 |
| capacity | 12,406.339 | 15,902.855 | 44 | 235,442.578 | 46,247 |
| delay (minutes) | 7.479 | 6.343 | 0 | 167 | 46,247 |
| fare (dollars) | 181.862 | 74.776 | 25.976 | 1,172.512 | 15,974 |
| **Airline-Market Level Variables** | | | | | |
| frequency | 101.434 | 143.540 | 1 | 5,468 | 95,181 |
| capacity | 12,705.975 | 21,608.755 | 44 | 797,156 | 95,181 |
| delay (minutes) | 7.704 | 7.900 | 0 | 191 | 95,181 |
| fare (dollars) | 182.257 | 77.023 | 25.083 | 1,172.512 | 35,252 |
| **Airline characteristics** | | | | | |
| LCC_carrier | 0.333 | 0.485 | 0 | 1 | 18 |
| employment (thousands) | 26.914 | 36.084 | 1.251 | 107.804 | 17 |
| cash (million dollars) | 0.506 | 0.865 | 0.000 | 3.215 | 17 |
| delay19q2 (minutes) | 12.517 | 3.189 | 5.842 | 19.379 | 18 |

Note: For variables we use in regressions, we report the mean, the standard deviations, the minimum values, the maximum values, and the number of observations. The variables frequency, capacity, and delay are monthly while the fare is quarterly. For the airline characteristics variables, we use the data in the second quarter of 2019. The employment variable is measured in thousands while the cash variable is expressed in million dollars units.

# 3 Empirical Strategy

## 3.1 Propensity Score Matching (PSM)

To address the economy's downward trend as a result of the COVID-19 pandemic, we employed propensity score matching to construct an untreated group, which allows us to identify the causal effect of regional airlines' exit on frequency, capacity, quality provision, and pricing. In particular, we categorize markets that have encountered an airline exit during our data sample as the treated group, while markets that have not experienced such exits serve as the untreated group.

To create a comparable untreated group, we use market variables before the exit of regional airlines to select markets that exhibited similar characteristics to the treated group. Specifically, we consider the market frequency, market capacity, market delay, and market fare in each quarter leading up to the quarter in which regional airlines exit.[14] In our sample, each market is defined by an origin city and a destination city. Consequently, market frequency and capacity for each market are calculated by aggregating the number of flights and the multiplication of the number of flights by the number of seats between these two cities. Market delay and fare are calculated as the quarterly averages for delay and fare within the market.

Figure 1 shows the propensity scores computed by the probit estimation. Most of the markets in the treated group and untreated group are on support while a small fraction of the markets are off support. In particular, we have 95,181 observations at the airline-market level with 7,0405 airline-market pairs and 46,247 observations at the market level with 2,416 markets that are matched in our final sample.

## 3.2 Difference-in-Differences Approach

To examine the causal effect of regional airlines' exit, we employ difference-in-differences models for average effects and event studies. For the average effect, we use the following re-

[14]Different from Rosenbaum and Rubin (1983), we do not use GDP as a matching variable due to the composition of our data sample. Our dataset comprises not only cities within Metropolitan Statistical Areas (MSA) but also includes other cities located outside of MSAs for which we lack relevant information.

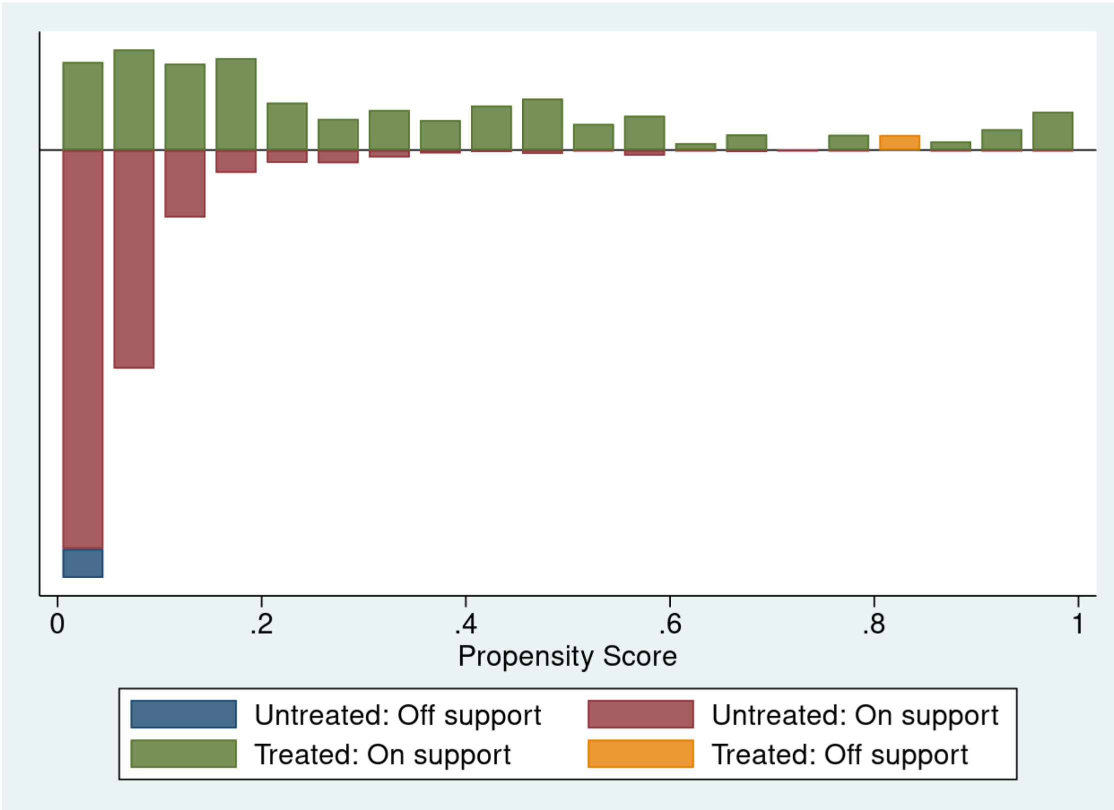



Figure 1: Propensity Score Matching Estimates

Notes: The figure depicts the propensity scores for treated and untreated observations. On-support means that we are able to find a matched city. Conversely, off-support means that we cannot find a matched city. We only keep the observations that are on support in our estimation.

gression equation, where $i$ denotes incumbent airlines, $m$ denotes the markets that incumbent airlines operate in, and $t$ represents time:

$$Outcome_{mt} = \beta_0 + \beta_1 post_t \times treat_m + \zeta_m + \zeta_t + e_{mt} \tag{1}$$

$$Outcome_{imt} = \alpha_0 + \alpha_1 post_t \times treat_m + \zeta_{im} + \zeta_t + e_{imt} \tag{2}$$

where $Outcome_{mt}$ represents frequency, capacity, delay and fare in market $m$ during time $t$ while $Outcome_{imt}$ represents frequency, capacity, delay and fare by airlines $i$ in market $m$ during time $t$. [15] Based on the result from the PSM method, $treat = 1$ if the market is in

[15] $t$ represents month when $Outcome$ is frequency, capacity and delay. $t$ represents quarter when $Outcome$

the treated group and 0 otherwise. In equation 1, we include market FEs, $\zeta_m$, and time FEs, $\zeta_t$. $e_{mt}$ is the error term. We cluster our standard errors at the market level. In equation 2, we include airline-market FEs, $\zeta_{im}$, and time FEs, $\zeta_t$. $e_{imt}$ is the error term. We cluster our standard errors at the airline-market level.

$\beta_1$ and $\alpha_1$ are our main interests. We expect that $\beta_1$ is negative and significant for frequency, capacity, and delay. For the average market fares, we expect $\beta_1$ to be positive and significant. We expect that $\alpha_1$ is positive and significant for frequency, capacity, and fare. For delay, we expect $\alpha_1$ to be negative and significant.

To test for pretrends and to understand the timing of competitive effects, we follow Babina et al. (2023) and estimate the dynamic event study version of equation 1 as:

$$Outcome_{m\tau} = \beta_0 + \sum_{\tau=-12(-4)}^{T} \beta_\tau post_\tau \times treat_m + \zeta_m + \zeta_\tau + e_{m\tau} \tag{3}$$

The vector $post_\tau$ is composed of dummies for each month (quarter) around the exit, ranging from 12 months (4 quarters) before to 8 months (2 quarters) after. [16] The other items are as defined above.

# 4 Results

## 4.1 Market-level Results

In this section, we study the competitive effects of regional airline exits at the market level. We first report our baseline results at the market level in Table 3 and consider the dynamic effects of regional airlines exit in Figure 2. We include Market and Month fixed effects in the regressions for frequency, capacity, and delay while for fare-related regressions, Market and Quarter fixed effects are included. [17]

is fare.

[16]The timing variable $\tau$ is zero in the month (quarter) of the airlines' exits, which is April (the second quarter) in 2020. $\tau$ starts from $-12$ when we regress on frequency, capacity, and delay while from $-4$ when we regress on fare.

[17]It reflects the varying data levels—market-month for frequency, capacity, and delay, and market-quarter for fare.

#### 4.1.1 Baseline Results at Market Level

In column (1) of Table 3, we observe a substantial 22.1% reduction in the number of flights within markets where regional airlines have exited, as compared to markets where such exits haven't occurred during our data period. This reduction highlights a significant shrinkage in flight availability after the exit of regional airlines. In column (2), we replace frequency with capacity, measured by the multiplications between the number of flights and the number of seats in each flight. The result is similar to column (1) – with a regional airline's exit, there is a 17.7% decrease in the capacity in the markets with exit compared to the markets without exit, affirming that the exit of regional carriers does not trigger immediate entries of new airlines to fill the void.

In line with a substantial body of literature exploring on-time performance within the airline industry, our study directs its attention to the impact of regional airline exits on this crucial metric. Building upon the insightful work of Ozturk et al. (2016, citation), which delineates that exits could result in higher prices in the automotive industry due to tempered competition or lower prices due to reduced agglomeration benefits, our research embarks on an exploration of how the exit of regional airlines, particularly amid the COVID-19 pandemic, could exert influence on pricing in the airline industry. In specific, we examine the impacts of regional airline exits on the quality of services, which is measured by the arrival delays in minutes, and airfare of the incumbent airlines. We report the results in columns (3) and (4), respectively. Regarding the quality of services, our result suggests that the markets with regional airline exits experienced a 21.2% decrease in arrival delays compared to the markets without such exits. Switching our focus to airfare in column (4), we find an average increase of approximately 3.7% in markets affected by regional airline exits, compared to those without such exits. This suggests that regional airline exits correlate with higher airfare. With less competition, incumbent airlines are capitalizing on this by elevating their airfare, concurrently focusing on improving their on-time performance.

In summary, our findings emphasize the multifaceted consequences of regional airline exits. While they indeed lead to higher airfare, they also contribute to improved service quality. Incumbent airlines strategically navigate this landscape, seizing market share and enhancing their punctuality to ensure a high-quality service, even if it entails increasing the price of air travel.

Table 3: Baseline Results at the Market Level

| | (1) Frequency | (2) Capacity | (3) Delay | (4) Fare |
|---|---|---|---|---|
| post×*treat* | −0.221*** | −0.177*** | −0.212*** | 0.037** |
| | (0.032) | (0.030) | (0.023) | (0.016) |
| Market FEs | Yes | Yes | Yes | Yes |
| Month FEs | Yes | Yes | Yes | No |
| Quarter FEs | No | No | No | Yes |
| $R^2$ | 0.877 | 0.878 | 0.442 | 0.894 |
| $N$ | 46,247 | 46,247 | 46,247 | 15,974 |

Note: This table shows the regression results at the market level. Column 1 reports the result on frequency, which is measured by the number of flights. In column 2, we replace frequency with capacity, which is measured by the multiplications between the number of flights and the number of seats in each flight. Column 3 presents the result on quality service, measured by arrival delays in minutes, and column 4 shows the result on air ticket fare. We take the log of frequency, capacity, and fare and we take the log of (delay+1) and cluster the standard errors at the market level. Significance levels are *** p<0.01, ** p<0.05, * p<0.1.

#### 4.1.2 Dynamic Effects

Figure 2 plots the dynamic effects of regional airline exit on the frequency, capacity, delay, and market fare. We consider the period of the event as 0 and normalize the values for the period preceding the event to 0. In specific, we denote month 0 as the month in which the regional airlines exit the market and define all other months relative to that point (e.g., if the airline exits in April 2020, March 2020 is labeled as -1, and May 2020 is +1). We include market and month-fixed effects in the regression. Panel (a) depicts coefficients for frequency and suggests that one month after the regional airline exits the market, there is a larger decrease of approximately 20% in the number of flights within that market. This decline continued into the second month following the airline exit, reaching an approximate 40% reduction. After that, the number of flights recovered in the market with airline exits.

Subsequently, frequency begins to recover in markets affected by airline exits. Importantly, there is no consistent pretrend before the exits. Panel (b) displays coefficients for capacity and reveals similar results to panel (a).

Panel (c) and Panel (d) present the event study coefficients for market delay and market fare, respectively. In Panel (c), we observe a marked reduction of around 25% in market delays following the exit of regional airlines, with a subsequent return to the original levels after 2 months. In Panel (d), market fares exhibit a significant increase after the exit of regional airlines, stabilizing at the 3% level after 2 quarters. It is noteworthy that there is no consistent pre-existing trend before these exits. Our findings suggest that following the exit of airlines from the market, incumbent carriers swiftly improved the quality of their services to attract a larger consumer base. As they secured market shares from the departing airlines, their on-time performance returned to its initial level. In pursuit of better service quality, incumbent airlines also adjusted their pricing strategies, ultimately maintaining prices at a level higher than those in effect before the exit of the airline.

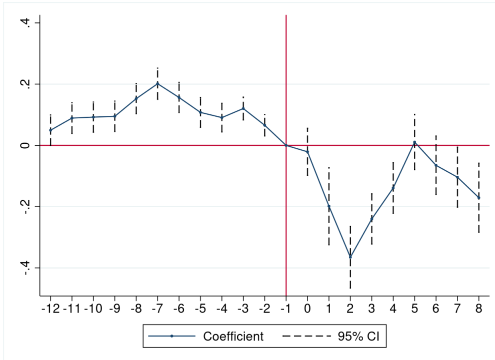
## 4.2 Airline-Market Level Results

In this section, we study the competitive effects of regional airline exits at the airline market level and show our results in Table 4. We first show our baseline results at the airline market level in panel A and consider the heterogeneity of airlines in panel B. In columns (1) to (3), we apply fixed effects for the airline-market and month, while column (4) introduces fixed effects for the airline-market and quarter.[18]

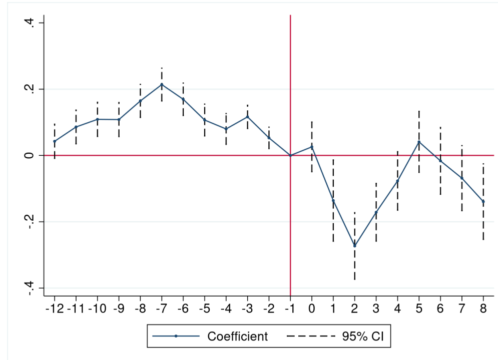
### 4.2.1 Baseline results at Airline-Market Level

Columns (1) and (2) in panel A of Table 4 present that incumbent airlines expanded their flight operations in markets affected by the exit of regional airlines, showing an increase of approximately 11.7% in the number of flights and a 12.2% growth in capacity. Combining these findings with the results outlined in Section 4.1, we conclude that despite an overall reduction in the total number of flights within markets where regional airlines exited, the

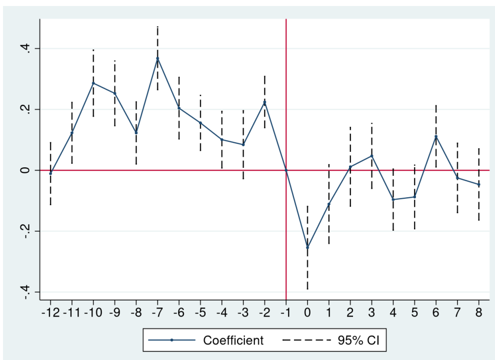
[18] Similar to Section 4.1, the data on frequency, capacity, and delay is at the airline-market-month level, while the data on the fare is at the airline-market-quarter level.



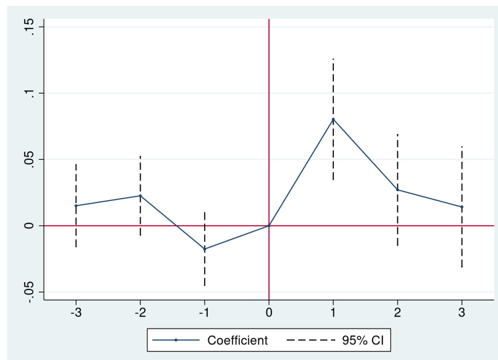

(a) Frequency




(b) Capacity




(c) Delay




(d) Fare

Figure 2: The Dynamic Effect of Airline Exit at the Market Level

Notes: Panels (a) and (b) plot the dynamic effect of airline exit on the number of flights (frequency) and the number of passengers (capacity). Panel (c) plots the dynamic effect of regional airline exit on the on-time performance in the market of the incumbent airlines (delay). Panel (d) plots the dynamic effect of airline exit on the average air ticket fare in the market of the incumbent airlines.

incumbent airlines exhibited a proactive stance. They managed to augment their flight operations by effectively seizing and capitalizing on market share previously held by the exiting carriers.

We show the estimates on delay and fare in columns (3) and (4) in panel A of Table 4. Column (3) reveals a significant 19.2% reduction in arrival delays by incumbent airlines operating in markets with regional airline exits, in comparison to markets unaffected by such exits. This outcome indicates that incumbent airlines are effectively seizing the market share of departing regional airlines by enhancing their punctuality. In Column (4), we observe a distinct pattern: incumbent airlines increase their prices by 3.1% in the markets with regional airlines' exits relative to markets without such exits. In summary, our results suggest that the incumbent airlines respond to the exits of their competitors not by reducing prices but by expanding their services and enhancing service quality. This strategic approach allows them to thrive in the wake of market exits.

### 4.2.2 Heterogeneity Effects

Furthermore, we study the heterogeneous effects of regional airline exits on incumbent airlines' frequency, capacity, quality provision, and pricing using equation 3 and present our results in panel B of Table 4. In particular, we interact the indicator of regional airline exits with the incumbent airlines' characteristics, including incumbent airlines' cost, size, cash, and on-time performance. We use a dummy variable *LLC_carrier* to represent incumbent airlines' operating costs. When an incumbent airline operates as an LLC, we denote *LLC_carrier* as 1, otherwise, 0.[19] We use employment to measure an airline's size. Larger employment numbers are indicative of larger airlines, which often command a greater market presence. We also consider an airline's cash reserves which refer to the readily available cash or easily accessible funds that airlines maintain to cover operational expenses, service debt obligations, invest in growth opportunities, and navigate unforeseen challenges. Airlines with substantial cash reserves are expected to have a competitive advantage in expanding their market share. Finally, we consider an airline's on-time performance, which is measured by the number of minutes of arrival delays. Airlines with better on-time performance are more likely to attract and retain customers, which can potentially lead to an increase in market share as punctuality reflects a commitment to customer satisfaction and reliability.

Column (1) in panel B reports the effects on frequency. The coefficient on the interaction term with *LLC_carrier* is positive and significant, while the interaction term with employment is negative and significant. In particular, low-cost incumbent airlines experience a significant 37.8% increase in their frequency, and smaller airlines experience a significant 1% increase in their frequency following the exit of regional airlines. These results suggest that low-cost and smaller airlines are adept at capturing a greater share of markets from the

[19] A low-cost airline (LLC) is an airline that is operated with an especially high emphasis on minimizing operating costs and without some of the traditional services and amenities provided in the fare, resulting in lower fares and fewer comforts.

departing regional carriers, especially low-cost carriers which are the main competitors for the regional airlines that exit the market. The coefficients associated with the interaction term involving cash and arrival delays are insignificant, suggesting that the financial condition and on-time performance do not matter for incumbent airlines to increase their market share. We show the effects on capacity in column (2) in panel B and find similar results as in column (1).

In columns (3) and (4), we investigate the heterogeneous effects on delay and fare, respectively. We find that low-cost incumbent airlines experienced a 13.2% increase in their arrival delays (5.6% increase in their pricing). Similarly, smaller incumbent airlines experienced a 0.2% increase in their arrival delays (0.2% increase in their pricing) when compared to larger airlines. Additionally, carriers with greater cash reserves tend not to enhance their on-time performance significantly following exits, in contrast to carriers with fewer cash reserves. However, they tend to increase their prices. On the other hand, carriers with poorer on-time performance tend to improve their on-time performance as well as reduce their prices when there is an exit in the market to attract more consumers.

In summary, our results suggest that low-cost and smaller airlines capture larger markets from the exiting regional airlines. However, at the same time, they offer worse on-time performance and higher prices. This is because low-cost and smaller carriers are the main competitors before the regional airlines exit. Therefore, when their competitors exit the market, they face less competition, which results in worse quality services and higher prices. Conversely, worse on-time performance carriers tend to decrease their arrival delays, providing better services to consumers. The carriers with substantial cash reserves tend to charge higher prices, largely due to their financial capacity to operate in the market.

Table 4: Baseline Results at the Airline-Market Level

| | (1) Frequency | (2) Capacity | (3) Delay | (4) Fare |
|---|---|---|---|---|
| | | **Panel A** | | |
| post×*treat* | 0.117*** | 0.122*** | −0.192*** | 0.031*** |
| | (0.041) | (0.041) | (0.021) | (0.011) |
| $R^2$ | 0.706 | 0.743 | 0.439 | 0.912 |
| $N$ | 95,181 | 95,181 | 95,181 | 35,252 |
| | | **Panel B** | | |
| post×*treat* | −0.100* | −0.105** | −0.276*** | −0.017 |
| | (0.054) | (0.054) | (0.030) | (0.015) |
| post×*treat* × *LCC_carrier* | 0.378*** | 0.410*** | 0.132*** | 0.056** |
| | (0.086) | (0.084) | (0.046) | (0.023) |
| post×*treat* × *employment* | −0.010*** | −0.010*** | −0.002** | −0.002*** |
| | (0.001) | (0.001) | (0.001) | (0.000) |
| post×*treat* × *cash* | −0.033 | −0.036 | 0.044 | 0.044*** |
| | (0.060) | (0.060) | (0.031) | (0.015) |
| post×*treat* × *delay* | −0.021 | −0.031* | −0.050*** | −0.015*** |
| | (0.017) | (0.017) | (0.009) | (0.004) |
| $R^2$ | 0.711 | 0.746 | 0.437 | 0.913 |
| $N$ | 94,107 | 94,107 | 94,107 | 34,846 |
| Airline-Market FEs | Yes | Yes | Yes | Yes |
| Month FEs | Yes | Yes | Yes | No |
| Quarter FEs | No | No | No | Yes |

Note: We take the log of frequency, capacity, and fare and we take the log of (delay+1). *LCC_carrier* denotes 1 if the airline is LCC, otherwise, 0. We take the demean of airlines' employment, cash, and arrival delays. We use the data on airlines' employment, cash, and arrival delays in the second quarter of 2019, which is the beginning period in our sample. We cluster the standard error at the airline-market level. *** p<0.01, ** p<0.05, * p<0.1.

# 5 Conclusion

We examine the competitive effects of regional airline exit on frequency, capacity, quality provision, and pricing based on the airline-market-time level data from the U.S. between April 2019 and December 2020. The identification of competitive effects comes from the exogenous shock to the survival of regional airlines during the COVID-19 pandemic. Our empirical analysis based on the propensity score matching and difference-in-differences model leads to several conclusions. First, market frequency and capacity decreased significantly after regional airlines exited the market, which implies that there is no immediate entry of new airlines into the market. Second, market on-time performance improves shortly after regional airlines' exit but returns to the original level at the end. Importantly, the market fares exhibit a significant increase post-exit, signaling a less favorable scenario for consumers.

In light of these findings, we further investigate whether the incumbent airlines are affected by regional airlines' exit differently due to their heterogeneity. We find that incumbent airlines increased their frequency and capacity after their competitors exit the market. In particular, low-cost and smaller airlines capture more markets from the exiting regional airlines. However, at the same time, they tend to provide worse on-time performance and higher prices. Similarly, carriers with substantial cash reserves tend to also charge higher prices, largely due to their financial capacity. Conversely, worse on-time performance carriers reduce their arrival delays and charge lower prices. Collectively, our findings reveal the multifaceted nature of competition dynamics in the airline industry, particularly when regional airlines exit the market. These insights have significant implications for consumers, airlines, and policymakers, shedding light on the potential market power shifts among incumbent airlines in the wake of such exits. Our study informs the design of effective regulatory and competitive policies within the airline industry.

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