

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 during the period April 2019 through December 2020, leveraging the first wave of COVID-19 pandemic as a natural experiment. Using propensity score matching and difference-in-differences strategies, we find that, on average, consumers are worse off after the exits. When a market experiences a regional airline exit, there is a significant 16% decrease in flight availability with no immediate replacements and a rise in the average fare by roughly 6%. The adverse supply outcome is mitigated for longer-haul markets and markets dominated by full-service carriers. Turning to the competition dynamics after the exits, incumbent airlines expand their services and raise their fares. Competing regional airlines and airlines with greater cash reserves are more able to seize market share after the exits. Fares rise, but to a lesser extent for competing regional airlines. And the exits have less impact on-time performance.

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

JEL Classification: L93, R40

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1 Introduction

This paper analyzes the competitive effects of regional airline exits in the U.S. during the first year of COVID-19. Unique to this study is a focus on the regional airlines and how their exits affect incumbents' flight frequency, capacity, pricing, and quality provision. Regional airlines are an integral part of the domestic aviation market. Regional airlines play a pivotal role in connecting small communities to the air transportation network and their economic impact is significant, providing more than one million jobs, generating \$41 billion in local wages and tax revenues, and whose total economic impact exceeds \$150 billion (Regional Airlines Association 2021, 2023). In 2020, 627 airports provided regional airline service, 439 of which provided only regional service. In contrast to major airlines that serve 34% of the domestic airports, regional airlines serve 94% (Regional Airlines Association 2021).

Similar to the major carriers, COVID-19 pandemic and associated travel restrictions had a dramatic impact on regional airline service. Between 2019 and 2020, average daily departures decreased from 10,447 to 6,424, and enplaned passengers fell from 165.2 million to 73.3 million, average load factors, average departures fell. Nonetheless, during the same period, as a proportion of total departures, regional airline departures increased from 40% to 42% which reflects market restructuring by the major carriers. More recently, between 2020 and 2024, United, Delta, and American Airlines collectively exited 62 markets and the low and ultra-low cost carriers exited 52 markets (Regional Airlines Association 2024).

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). With the onset of the pandemic, the most vulnerable regional carriers ceased operations, starting with the bankruptcy announcement of Trans States Airlines in February 2020.¹ Consequently, many cities found themselves without regional airline services, prompting residents to resort to buses for transportation to hub airports. For instance, residents of Fort Collins now rely on bus services to reach Denver airport due to the absence of regional airline options, resulting in a longer travel time. Understanding how regional airline exits affect consumers in the smaller communities is an important objective of this study.

¹Trans States Airlines officially ceased operations in April 2020.

We exploit the exits of Trans State Airlines and Compass Airlines during the COVID-19 pandemic to identify and estimate the competitive effects of regional airline exits on flight frequency, capacity, pricing and quality provision. Our empirical approach combines propensity score matching (PSM) and difference-in-differences (DiD) methods to analyze regional airline markets, defined as a non-directional origin-destination pair. The markets with regional airline exits constitute the treatment group, while the markets without exits constitute the control group. Since markets with a regional airline exit might not be selected randomly, we employ a PSM methodology to construct a control group of markets without an exit that uses observables to account for the selection issue. For instance, consider the treated market Los Angeles-Albuquerque, which faced an airline exit during COVID-19. This market is a hub airport connecting with a small community in the western United States. If we were to randomly select a market like Burbank-Albuquerque, which differs significantly in terms of market population and hub status from the treated market, it could introduce biases into our analysis. To address this potential bias, we use PSM to identify a market closely resembles the treated market, such as New York City-Arlington, in terms of market population, hub status, and other relevant factors. Then, we employ DiD methods with two-way fixed effects (FEs) to control for the unobserved heterogeneities across markets and the aggregate trends in airline market outcomes.

Our empirical analysis employs several datasets covering the U.S. during the period from April 2019 to December 2020, which is before the second wave of the COVID-19. Using OAG Analyzer, we collect daily flight schedules in each market. In particular, we observe the number of flights and seating capacity operated by each airline in each market. From that information, we aggregate the daily number of flights (capacity) to construct quarterly flight frequency (capacity). We also collect information on ticket fares, departure delays, employment, and financial data from the Bureau of Transportation Statistics (BTS) to measure airline pricing, quality provision and characteristics.² The analysis of flight frequency, capacity, prices and delay is at the market-year-quarter and airline-market-year-quarter levels depending on the specified empirical model used.

²We also use the minutes of arrival delays to construct the on-time performance variable and find similar results.

Our analysis leads to the following conclusions. First, market-level flight frequency decreases significantly by about 16% after the regional airlines exit. In other words, the incumbent and potential entering airlines do not make up the lost supply after the exits. The market-level average airfare increases by about 6% (\$13) and the market-level average delay decreases by about 8% (1 minute) compared to the control group. We obtain these results by incorporating four sample selection restrictions and we find our results robust to alternative sample selection criteria. Further, in an event study, we find that there are no pre-trends for our four market-level outcome variables relative to the control group. Our event study results also show that market-level flight frequency increases and average airfare decreases in the quarter of regional airline exits and those two market-level outcomes stay at their new levels until two quarters after the exits. Nonetheless, market-level average delay decreases shortly after the regional airlines exit, but returns to its pre-exit level after a quarter. Overall, our results suggest that consumers are worse off after the regional airlines exit.

Further, we explore the market heterogeneity in those four market-level outcomes. First, we find that regional airline exits impact longer-haul markets less, which suggests that those remote markets qualify for the FAA’s program of essential air services (EAS) to support their aviation services. Second, exiting regional airlines are contractors of full-service carriers (FSCs). We find markets in which exiting regional airlines have a higher market share experience a larger increase in flight supply. This suggests that FSCs preempt those markets by expanding their services after the exits.

Finally, we extend our empirical model to airline-market-year-quarter level to examine the competitive dynamics of incumbent airlines after the regional airlines exit. On average, we find that incumbent airlines increase their flight frequency and passenger capacity, despite the market-level flight frequency and passenger capacity decrease. Consequently, the incumbent airlines charge a higher fare after the exits. Interestingly, we find the incumbent regional airlines capture more market shares from the exiting regional airlines, while low cost carriers (LCCs) and FSCs decrease their flights. After the exits, regional airlines raise their fares to a lesser extent than their LCCs and FSCs counterparts. These results suggest that product similarity drives the post-exit market share dynamics. Moreover, airlines with more cash reserves acquire more market shares from the exiting regional airlines, which

suggests that having sound financial capacity supports an expansion of their services during the COVID-19 pandemic. However, the exits have no clear impacts on their on-time performance.

The outline of the paper is as follows. We present the conceptual framework and relevant literature in Section 2. We introduce background and data in Section 3 and the empirical strategy in Section 4. Section 5 reports the results. Section 6 concludes.

2 Conceptual Framework and Literature Review

This section first discusses a conceptual framework that summarizes the causal relationships between regional airline exits, incumbent airline performances, and market outcomes. The section then reviews the literature and outlines our contributions to the existing body of research.

2.1 Conceptual Framework

There are multiple channels through which exits affect the price and quality of remaining airlines. First, exits reduce competition when they result in fewer airlines operating in a market. Since airlines employ price and/or quality to compete with each other, they may raise prices and compromise quality in response to reduced competition (Borenstein 1990; Kim and Singal 1993; Prince and Simon 2017; Chen and Gayle 2019). This is the *market power channel*. Second, exits result in a loss of agglomeration of airlines in a market. Agglomeration benefits derive from labor pooling, i.e. several airlines operating in the same market that attracts a large skilled labor pool and a cluster of intermediate input suppliers (Duranton and Puga 2004). The loss of an airline may drive away some of the input resources in the market, which in turn raises input costs that generate incentives to increase prices and decrease quality (Ozturk et al. 2016). This is the *agglomeration channel*.

Third, exits may allow the remaining airlines to exploit scale economies to achieve cost savings. Previous studies find that U.S. airlines enjoy scale and scope economies. For example, larger airlines exploit scale economies from network size (Jara-Díaz et al. 2013; Johnston and Ozment 2013) and scope economies by offering freight services (Hofer and

Eroglu 2010). The cost savings can pass through to lower airfares (Hofer and Eroglu 2010; Johnston and Ozment 2013). Further, if airlines invest the realized cost savings in quality enhancement, the service quality of the incumbent airlines might improve. This is the *cost efficiency channel*.

The overall effect of exits on the price and quality of the incumbent airlines needs to be studied. A unique feature of regional airline exits relates to the markets they had served before ceasing operation. The regional markets are in consist of smaller communities with lower populations and few operating airlines. Gillen and Hazledine (2015) reports that regional airline markets resemble a market structure with a dominant airline with 90% market share, whereas the market structure of traditional/longer-haul markets resembles a symmetric duopoly. Regional airline exits have substantial impact on the market structure. Thus, exits are likely to transform the regional market into a monopoly market structure, which substantially enhances the market power of incumbent airlines which outweighs the potential cost savings. Further, regional airlines are relatively small. These exits may have limited impacts on the agglomeration economies in the markets they serve. On the other hand, because entry by competitors is relatively easy, market power in regional airline markets is limited. Morrison and Winston (1987), for example, empirically demonstrate that domestic airline markets are imperfectly contestable, that is, actual relative to potential competitors have a larger impact on consumer welfare. Consistent with Gillen and Hazledine (2015), Morrison and Winston's results indicate that the net effect of an exiting airline, all else constant, from a contestable market enhances market power and reduces consumer welfare, but not to the same extent as exiting a non-contestable market.

Turning to the impacts on flight frequency and capacity, regional airline exits are a positive shock to the incumbent airlines. Incumbents expand their services to capture the consumers who would have taken the exiting airlines if no exit had occurred. However, the exploitation of market power through price increases may ultimately lead to decreased flight frequency and capacity at the market level.

The above analysis leads to our main hypotheses at the market level and market-airline level as follows:

H1: After the regional airlines exit, the market-level flight frequency and capacity de-

creases. Market-level average prices increase and service quality improves.

H2: After the regional airlines exit, the incumbent airlines increase their flight frequencies and capacities. The incumbent airlines also raise their prices and improve their service quality.

2.2 Literature Review

This paper contributes to three strands of literature. This study extends a growing empirical literature that examines the competitive effects of airline exits in the U.S.³ Daraban and Fournier (2008) examines the exits of LCCs during 1993-2006 and find that the average market fare increases after LCC exits. Bachwich and Wittman (2017) examines the exits of LCCs during 2010-2015 and find that the incumbent airlines increased prices by about 10% after the exits. In a closer relationship to this work, Hüscherlath and Müller (2013) examines the exits of five airlines during 1995-2010 and find that the incumbent airlines increase prices by 12% and decreases passenger service by 15% after the exits.

Our work also examines the effects of airline exits but extends the previous work in several aspects. First, airline exits can be a response to incumbent strategies, such as price wars and capacity expansions, which potentially exaggerate the price increase and frequency decrease after airline exits. In contrast, we analyze the airline exits during the COVID-19 pandemic, which serves as an exogenous shock to airline exits and provides more credible inferences on the competitive effects of airline exit. Concerns about endogeneity arise when studying the effects of exits in other periods, as these exits could be influenced by airlines' financial conditions or market shares. However, we address this concern by leveraging the COVID-19 pandemic. This period serves as an exogenous shock to airline exits, reducing reverse causality concerns and allowing for more accurate identification of the causal effects of airline

³There is also literature exploring the competitive effects of airline exits on 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 services 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. Eugrino-Martin and Perez-Granja (2022) examine the exits of charter airlines Monarch and Thomas Cook and find that the incumbent 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 the lost passengers after the exit of Thomas Cook.

exits. Second, we investigate the redistribution of market shares from the exiting airlines to the incumbent airlines and explore the determinants, such as the similarity between exiting and incumbent airlines, driving the redistribution. Third, we not only focus on prices and passengers carried but also examine the competitive effect on service quality.

This study also 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 to protect economic activities. Larger airlines would benefit from supporting policies, while smaller airlines might exit the market. Indeed, there is country-level evidence showing large airlines benefit during the COVID-19 pandemic. Albers and Rundshagen (2020) suggests the bailout of Alitalia during the COVID-19 pandemic may distort competition and Ng. et al. (2022) documents 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 the COVID-19 pandemic. Such increase is larger for LCCs than FSCs, and is larger for airports with one operating airlines than airports with multiple operating 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 flight frequency, fares and service quality of airline exits in the U.S. during the COVID-19 pandemic. Our results inform on how such airline exits adversely affect consumers.

This study further adds to the recent literature on the growing concentration in various industries in the U.S. that would potentially harm consumers (Council of Economic Advisers, 2016; Autor et al. 2020). 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. In fact, the market concentration in the U.S. airline industry had surpassed that of the European airline industry despite their concentrations were similar in the 1990s (Gutiérrez and Philippon 2018). In contrast to examining the consolidation of the airline industry at the aggregate level, our work provides novel evidence on how small communities experience the adverse impacts of industry consolidation of the airline industry (Regional Airline Association

2019).

3 Background and Data

3.1 Airline Exits during the COVID-19 Pandemic

The COVID-19 pandemic had a profound impact on the airline industry in the U.S. Many U.S. airlines 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, network reconfigurations, furloughs, and retirements of older aircraft. Some airlines also exited certain markets, either ceasing operations temporarily or exiting the market permanently.

Table 1 documents the list of U.S. airlines filing bankruptcy in 2020. The exiting airlines include Trans State Airlines, Compass Airlines, and Ravn Air Group, which are all regional airlines.⁴ Trans State Airlines was the first to cease operations and declared bankruptcy on April 1, 2020. Subsequently, Compass Airlines exited, 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. In contrast, Miami Air International’s attempts to follow a similar path were unsuccessful, leading to the permanent cessation of its charter flight operations on May 8, 2020.⁵

In this paper, we focus on Chapter 7 bankruptcy.⁶ The exit events we examine include those of Trans State Airlines and Compass Airlines. Coincidentally, the two exit events we examine involve regional airlines with contractor business models. In other words, Trans State Airlines and Compass Airlines act as contractors of FSCs. Trans State Airlines operate for American Airlines and United Airlines. Compass Airlines operate for American Airlines and Delta Airlines (Reynolds-Feighan 2018). We do not examine the airlines that underwent Chapter 11 bankruptcy, since they continue to operate and restructure under the supervision

⁴They are all members of [Regional Airline Association \(RAA\)](#).

⁵The OAG database does not include flight schedule information on Miami Air International, so we exclude this airline exit in our analysis.

⁶Chapter 7 bankruptcy involves selling off an airline’s assets to pay debts. It’s like closing down the airline and liquidating everything. On the other hand, chapter 11 bankruptcy allows the airline to keep operating while it reorganizes and makes a plan to repay debts. It’s about restructuring to stay in business.

of a court-appointed trustee, to emerge from bankruptcy as a viable business.

Table 1: Bankruptcy of U.S. regional airlines in 2020

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

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

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.

3.2 Data and Variables

3.2.1 Market Definition and Selection

We define a market as a non-directional origin-destination airport pairs. For example, a flight travels from Lehigh (ABE) to Chicago (ORD) is in the same market as another flight travels from ORD to ABE. Our final data is a unique airline-market-year-quarter combination.

In order to analyze the competitive effects of regional airline exits on the respective markets, our research design applies four selection criteria to generate the estimation sample. First, following Mumbower (2022), we exclude the markets with destinations in Alaska, Hawaii, and U.S. territories as they were subject to government-imposed flight suspensions, inbound quarantine, and border closings during the COVID-19 pandemic. Second, we exclude markets only with the exiting airlines, Trans State or Compass Airlines, providing services because there is no incumbent airlines. Third, we exclude markets in which the exiting airlines being inactive in at least one quarter before the exit. We also require that the markets have at least one incumbent airline per quarter. Fourth, we exclude the flights with one stop or more.

3.2.2 Treated Markets

Our treated markets include the origin-destination pairs that Trans State Airlines and Compass Airlines operated before 2020 Q2. There are 96 treated markets in our sample. All treated markets involve 4 hub airports, namely Chicago, Denver, Los Angeles, Seattle, and Las Vegas. This sample of treated market is consistent with the nature of our exiting regional airlines. They serve to connect smaller communities to the hub airports of American Airlines (Chicago and Los Angeles), Delta Airlines (Seattle), and United Airlines (Chicago, Denver and Los Angeles). Among 96 treated markets, 34 markets connect to Chicago, 33 markets connect to Denver, 13 markets connect to Los Angeles, 11 markets connect to Seattle, and 2 markets connect to Las Vegas. According to the population information, Table 2 reports that except Las Vegas, the population in cities hosting the spoke airports at about 10% to 40% of that in cities hosting the hub airports. This suggests that our markets involve connecting smaller communities to hub airports.

Table 2: Hub Airport in Treated Markets

Hub Airport	Number of Markets	Hub Population	Spoke Population
Chicago city, IL	34	2,746,352	259,521
Denver city, CO	33	715,538	241,882
Los Angeles city, CA	13	3,898,767	748,967
Seattle city, WA	11	737,018	314,419
Las Vegas city, NV	2	644,866	1,200,091

Note: The table lists the hub airports in the treated markets, the number of treated markets, the population of the city where the hub airport is located, and the average market population. We obtained the city population data from the United States Census Bureau in 2020. We exclude the markets where both origin and destination are the listed 5 hub airports.

3.2.3 Flight Frequency and Seating Capacity

OAG Analyser provides data on flight frequency and seating capacity, which contains airline-level information on domestic daily flight schedules in the U.S. This database includes details such as the names of operating airlines, the departure and arrival airports, the duration of flights, the number of stops, the number of flights, and the seating capacity for the period

between 2019 Q2 and 2020 Q4.⁷

We construct the market-level flight frequency by aggregating the number of non-stop flights of all airlines in each market per quarter, and the market-level capacity by multiplying the number of non-stop flights and the number of seats on each flight.⁸ Although the capacity can not reflect the actual loading, it can provide an indication of how airline exits impact capacity at the minimum level.

3.2.4 Fare and On-time Performance

The ticket fare data comes from the Airline Origin and Destination Survey (DB1B Market). This dataset contains a 10% quarterly sample of all tickets collected by U.S. airlines. It includes the origin airport code, destination airport code, operating carrier, number of passengers, market fare, and miles flown. Following Das (2019), we exclude the tickets with fares that are unreasonably high or low, in particular, we drop tickets with fares below \$50 or above \$2000.⁹ The airline-market fare variable is computed by averaging the fares across tickets for each airline in each market and each quarter. The market-level average fare is computed by averaging the fares across tickets for all airlines in each market and each quarter.

BTS provides on-time performance data. This dataset includes information on scheduled and actual departure and arrival times, which enables us to track delays in both departure and arrival for each carriers in each airport in each month. To measure on-time performance, we use the minutes of departure delays, which is the difference in minutes between a scheduled and actual departure.¹⁰ This measure is commonly used in previous studies (Mayer and Sinai 2003; Lange 2019) and shown to have a direct impact on customer satisfaction (Tae et al. 2020). In particular, to compute airline-market level on-time performance, we take the average departure delay for each airline operating in each market quarterly. We compute

⁷Throughout the remainder of this paper, we will refer to seating capacity simply as "capacity" for the sake of convenience.

⁸Our study does not focus on aircraft cost efficiency, so we do not study the effect on available seat-miles (ASM) as many previous literature such as Greer (2008), Adler et al.(2014), and Li et al.(2015).

⁹About 8% of the sample has a market fare below \$50, while less than 1% has a fare above \$2000. Without this exclusion, the mean value of market fare is \$191.4, which is smaller than the mean value of market fare in our sample data \$206.5.

¹⁰A departure delay is 0 for early departures.

the market-level average departure delays by averaging the departure delay across airlines in each market quarterly.

We combine the three datasets— flight data, ticket fare data and on-time performance data —by matching them using airlines, markets, years and quarters.

3.2.5 Market Characteristics

We employ two market characteristics in our empirical analysis. First, we consider the distance between origin and destination airports. We obtain the distance variable from the BTS on-time performance dataset. We construct a distance dummy variable *Distance* which takes 1 if the distance between the origin and destination airports is longer than 210 miles and receive subsidies from EAS program in the treated market, and 0 otherwise.¹¹

Second, we consider the market share of exiting airlines, Trans State and Compass Airlines. We construct the market share *mktshare* using the average share of frequency of Trans State and Compass Airlines in the treated markets over the four quarters before the exit.¹² For the untreated markets, *mktshare* takes the value 0 as the exiting airlines, Trans State and Compass Airlines, did not operate in these untreated markets.

3.2.6 Airline Characteristics

We collect the LCC identifier from the International Civil Aviation Organization (ICAO) which provides information on LCCs all over the world based on ICAO definition. In the data, we observe countries, airline names, ICAO code, IATA code, start of operations, and whether they ceased operations. We collect the regional airline identifier from [Regional Airline Association](#).

BTS also provides airline financial data, including quarterly financial data, such as cash, comes from Air Carrier Financial Reports. The report contains operating balance sheet statements for large certificated U.S. air carriers with annual operating revenues of \$20

¹¹Essential Air Service (EAS) is a U.S. government program ensuring ongoing commercial air service for small communities previously served by airlines before 1978 deregulation. Its goal is to maintain basic air transportation, offering subsidies up to \$200 per passenger for communities over 210 miles (340 km) away from the nearest large or medium hub airport.

¹²We first calculate the total market shares of Trans State and Compass Airlines from 2019 Q2 to 2020 Q1, and then take the average of their total market shares.

million or more. We obtain the airline financial data in the period 2019 Q2 and merge it with our main dataset using the airlines' IATA code as an identifier.

3.3 Descriptive Statistics

Our data period is from 2019 Q2 to 2020 Q4. Table 3 presents the descriptive statistics of the main variables in our empirical analysis. At the market-quarter level, on average, the flight frequency is 1,026 flights per quarter, and capacity is 104,512 seats per quarter. In the treated group, the average frequency (capacity) is 1,273 (122,187), compared to 943.4 (98,600) in the control group. At the airline-market level, the average frequency and capacity are 358 flights and 37,433 seats respectively. In other words, in each market, there are about three airlines. Our sample airlines typically employ narrow-bodied jets to carry about 100 passengers per flight. For instance, our sample airlines frequently used the Airbus A220-100, which is equipped with 109 seats. Moreover, the market-level average fare charged in a quarter is \$206.5 and average departure delay in a quarter is 10.82 minutes. In specific, the market average fare in the treated group is \$201.2 compared to \$208.3 in the control group.¹³ And the market average departure delay is 10.78 minutes in the treated group, compared to 10.83 minutes in the control group.

Furthermore, the mean value of *Distance* is 0.123, which indicates that on average, 12.3% markets which are further than 210 miles receive subsidies from the EAS program, about the distance between Denver and Grand Junction, Colorado and the distance between Chicago and Traverse City, Michigan. In the treated group, the mean value of *Distance* is 0.489, compared to 0 in the control group, which suggests that about half of the markets in the treated group satisfies the requirement of EAS program and no market in the control group receives subsidies from the EAS program. The average market share of Trans State and Compass Airlines before exit is 5.1%.

31.4% and 61.6% of our observations come from LCCs and regional airlines, respectively. In the treated group, 24.8% airlines are LCCs and 68.7% airlines are regional airlines, compared to 34.7% LCCs and 58% regional airlines in the control group. Moreover, on average,

¹³The market fares are measured in nominal values. We report the results of market fares in real terms in the robustness checks in Table 5.

each incumbent airline holds approximately \$528,444 in cash. Treated group has \$451,535 in cash on average while control group has \$566,975 in cash on average.

Table 3: Summary Statistics

	Full Sample		Treated Group	Control Group	
Variable	Mean	SD		Before Matching Mean	After Matching Mean
Market Level Variables					
Frequency	1,026	963.6	1,273	648.4	943.4
Capacity	104,512	133,259	122,187	84,819	98,600
Fare (nominal dollars)	206.5	64.69	201.2	197.6	208.3
Delay (minutes)	10.82	7.458	10.78	9.850	10.83
Number of Observations	2,625	2,625	658	12,544	1,967
Airline-Market Level Variables					
frequency	358.3	384.7	320.0	329.9	376.5
capacity (passengers)	37,433	53,620	32,345	43,493	39,857
fare (nominal dollars)	200.5	67.52	193.2	197.4	203.9
delay (minutes)	11.92	13.57	11.76	10.59	12.00
Number of Observations	6,977	6,977	2,251	24,088	4,726
Market characteristics					
Distance	0.123	0.328	0.489	0	0
mktshare	0.051	0.118	0.202	0	0
Number of Observations	2,625	2,625	658	12,544	1,967
Airline characteristics					
LCC	0.314	0.464	0.248	0.470	0.347
Regional	0.616	0.486	0.687	0.364	0.580
Cash (nominal dollars)	528,444	925,565	451,535	565,370	566,975
Number of Observations	6,977	6,977	2,245	23,071	4,481

Note: For variables we use in regressions, we report the mean and the standard deviations for the full sample, as well as the mean value in the treated group and control group before and after matching. The variables *frequency*, *capacity*, *fare*, and *delay* are quarterly. The market characteristics, *Distance*, is a dummy variable. For the airline characteristics variables, both *LCC* and *Regional* are dummy variables. Regarding *cash*, we use the data from the second quarter of 2019.

4 Empirical Strategy

4.1 Propensity Score Matching (PSM)

To identify the competitive effects of regional airline exits, we need to control the confounding factors that make the markets experiencing exits comparable to the markets do

not experience exits. To select the control group of markets that are comparable to our treated markets, we proceed in two steps. First, we compile a list of incumbent airlines which competed with our two exiting airlines before they exit (see Table A.1). We only consider markets that contain those incumbent airlines as the set of potential control markets. Second, we employ a PSM methodology to construct the control group. PSM ensures comparability between the control group markets and the treated markets, thereby establishing a valid counterfactual scenario for comparison.¹⁴ Without using PSM, our treated market resembles a hub-and-spoke structure. Randomly selecting a market connecting two spokes could introduce significant discrepancies in market population, hub prominence, and airport capacity compared to our treated market, leading to biased results. To estimate the propensity score, we construct a cross-section sample that consists of the treated markets and the potential control markets. We adopt a Logit specification to model a market’s exit experience, that is, whether Trans State or Compass Airlines exited the market in 2020 Q2:

$$\frac{P_i}{1 - P_i} = X_i\alpha + \eta_i, \quad (1)$$

where P_i is the probability of a market i experiencing an exit. The set of explanatory variables X_i includes the market-level frequency, capacity, average fare, and average delay in all quarters before the exit 2020 Q2.¹⁵

Panel (a) in Figure 1 shows the estimated propensity scores.¹⁶ Most of the markets in the treated group and control group are on support while a small fraction of the markets are off support.¹⁷ Overall, the assumption of common support is mostly verified. Further, to ensure the matched markets are useful and appropriate, we only keep the on-support markets without missing weights. Panel (b) shows the comparisons of the covariates before and after

¹⁴Our experimental design also aligns with the ignorability assumption in propensity score matching. We have chosen market frequency, capacity, prices, and departure delays before exits for each period as covariates, which contain the information of time-invariant factors driving the outcome variables. By including these covariates, the relationships between airline exits and outcome variables are independent. In other words, apart from the covariates we considered, we assume there are no other unobserved confounding factors influencing this relationship, which satisfies the ignorability assumption.

¹⁵We do not use GDP as a matching variable as the GDP information provided by the Bureau of Economic Analysis is at the county or MSA level, which is wider than our market definition.

¹⁶We use 7-nearest neighbors matching and set the caliper at 0.05 level.

¹⁷On-support means that we can find a matched market, while off-support means that we cannot find a matched market.

matching. The standardized bias is reduced and smaller than 20% for all the covariates.

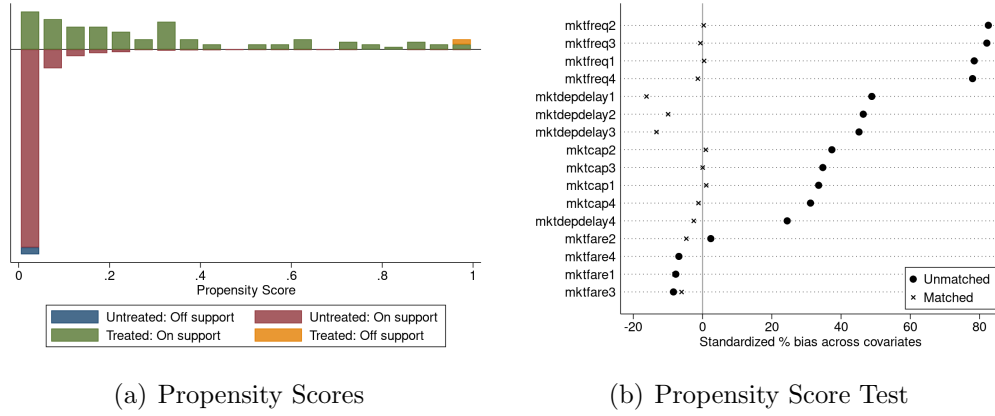


Figure 1: Propensity Score Matching Estimates

Notes: The figure depicts the propensity scores for treated and control observations. On-support means that we are able to find a matched market. Conversely, off-support means that we cannot find a matched market. We only keep the observations that are on support without missing weights in our estimation.

4.2 Difference-in-Differences Approach

To estimate the causal effect of regional airlines' exit on market-level outcomes, we employ the following DiD model:

$$Outcome_{mt} = \beta post_t \times treat_m + \zeta_m + \zeta_t + e_{mt} \quad (2)$$

where $Outcome_{mt}$ represents frequency, capacity, fare and delay in market m during quarter t .¹⁸ The treatment variable $treat_m = 1$ if the market is in the treated group and 0 otherwise, and $post_t = 1$ if the quarter is 2020 Q2 and after and 0 otherwise. We also include market FEs, ζ_m to control for unobserved market heterogeneity, and quarter FEs, ζ_t to control for aggregate trends in those market outcomes. e_{mt} is the error term. We cluster our standard errors at the market level to allow for serial correlation. The coefficient β is our coefficient of interest. According to Hypothesis 1, we expect that β is negative and

¹⁸ t represents year-quarter. In our sample data, we have 3 quarters in 2019 and 4 quarters in 2020. So t is from 1 to 7.

significant for frequency, capacity, and average delay. For the average fares, we expect β_1 to be positive and significant.

To test for pre-trends and to understand the timing of exit effects, we estimate the event study version of equation 2 as:

$$Outcome_{m\tau} = \sum_{\tau=-4}^2 \beta_{\tau} post_{\tau} \times treat_m + \zeta_m + \zeta_{\tau} + e_{m\tau} \quad (3)$$

We designate the event period as period 0, which is the second quarter in 2020. The vector $post_{\tau}$ is composed of dummies for each quarter before and after the exit, ranging from 4 quarters before to 2 quarters after. We normalize the values for the preceding period leading up to the event to 0 (period -1). The other items are defined the same as above. If the coefficients are all insignificant in the pre-exit periods, then we can conclude that there is no pre-trend.¹⁹

5 Results

5.1 Market-level Results

In this section, we report the competitive effects of regional airline exits at the market level. We first report our baseline results at the market level in Table 4 and then consider the dynamic effects of regional airline exits in Figure 2.

5.1.1 Baseline Results

Column (1) of Table 4 reports that there is a 162 flight reduction (or 16% of the mean) in the markets experiencing the regional airlines exit, compared to the control group. It highlights a significant shrinkage in flight availability after the exits of regional airlines. In other words, the exit of regional airlines does not trigger immediate supplies from other airlines to fill the void. Column (2) replaces the outcome variable with capacity. The coefficient β is

¹⁹Although our test fails to reject the null that there is no pre-trend, recent research cautions that tests of linear violations of parallel pre-trends have low power, which could bias treatment effect estimates. For this and related issues associated with treatment effect biases, see, for example, Roth (2022), Rambachan et al. (2023), and Borusyak et al. (2024).

negative, which is consistent with the results from flight frequency. However, the coefficient is insignificant.

Column (3) reports the results of market-level average fare. We find an approximate average fare increase of 13 dollars (or 6% of the mean) in the markets experiencing regional airline exits, compared to the control group. Regarding the service quality, Column (4) reports that the market-level average departure delay decreases by 1 minute (or 8% of the mean) in markets experiencing the regional airlines exit, compared to the control markets.

In summary, our findings emphasize the multifaceted consequences of the regional airlines' exits. While leading to a reduced availability of flight services, the exits also lead to higher airfares. Nonetheless, service quality, measured by departure delay, improves, which may relate to a less crowded flight schedule after the exit.

5.1.2 Dynamic Effects

Figure 2 plots the dynamic effects of regional airline exits on the market-level frequency, capacity, average fare, and average delay. Encouragingly, there is no significant pre-trend in all outcome variables before the regional airlines exit.

Panel (a) depicts the coefficients of frequency and suggests that one quarter after the regional airlines exit the market, the number of flights in the treated markets decrease by 200. After that, the number of flights recovers to 110 flights below the level observed one quarter before the exits, and stabilizes at that level. Panel (b) displays the coefficients of capacity and reveals a consistent pattern to panel (a) but the coefficients are insignificant.

Panel (c) depicts the coefficients of market-level average fare, which exhibit a significant increase after the regional airlines' exits, stabilizing at 12 dollars above that in one quarter before the exits. Panel (d) presents the coefficient of market-level average delay, which shows a reduction of about 1 minute in delays following the exits of regional airlines, with a subsequent return to the level in one quarter before the exits.

Our findings from event studies are consistent with those from DiD models. Additionally, flight frequency, average fare, and average delay respond swiftly in the quarter of exit. The findings also suggest that the regional airline exits are the driving force behind our DiD results. The responses of flight frequency and average fare are persistent into the second

Table 4: Market-Level Models

	(1) Frequency	(2) Capacity	(3) Fare	(4) Delay
Panel A				
<i>post</i> × <i>treat</i>	−162.007* (89.535)	−10,500 (13,643.210)	12.512*** (4.397)	−0.915* (0.492)
R^2	0.850	0.849	0.807	0.702
N	2,625	2,625	2,625	2,625
Panel B				
<i>post</i> × <i>treat</i>	−651.082*** (149.201)	−75,300*** (26,103.486)	11.724* (7.090)	−0.705 (0.652)
<i>post</i> × <i>treat</i> × <i>Distance</i>	683.539*** (130.126)	97,039.292*** (20,385.030)	−7.734 (7.392)	−1.284 (0.818)
<i>post</i> × <i>treat</i> × <i>mktshare</i>	1,020.025*** (373.011)	11,400** (53,044.292)	30.177 (24.068)	2.757 (3.325)
R^2	0.861	0.859	0.808	0.703
N	2,625	2,625	2,625	2,625
Quarter FEs	Yes	Yes	Yes	Yes
Market FEs	Yes	Yes	Yes	Yes
Mean of Dependent Variables	1,026	104,512	206.5	10.82

Note: The outcome variables are flight frequency in Column 1, capacity in Column 2, average fare in Column 3 and average delay in Column 4. Panel A reports the baseline results of Equation (3). Panel B interacts the *post* × *treat* variable with two market characteristics. We demean *mktshare*. We report the mean values of outcome variables at the market level in the last row. We include market and quarter-fixed effects in both panels A and B. The results in panel B are discussed in detail later in Section 5.1.4. The standard errors are clustered at the market level. Significance levels are *** p<0.01, ** p<0.05, * p<0.1.

quarter after the exit. These outcomes are consistent with reduced competition after the exit. Incumbent airlines capitalize on this by elevating their fares. Nonetheless, the positive impact on service quality is short-lived. Overall, our results suggest that consumers are worse off after the regional airlines' exits.

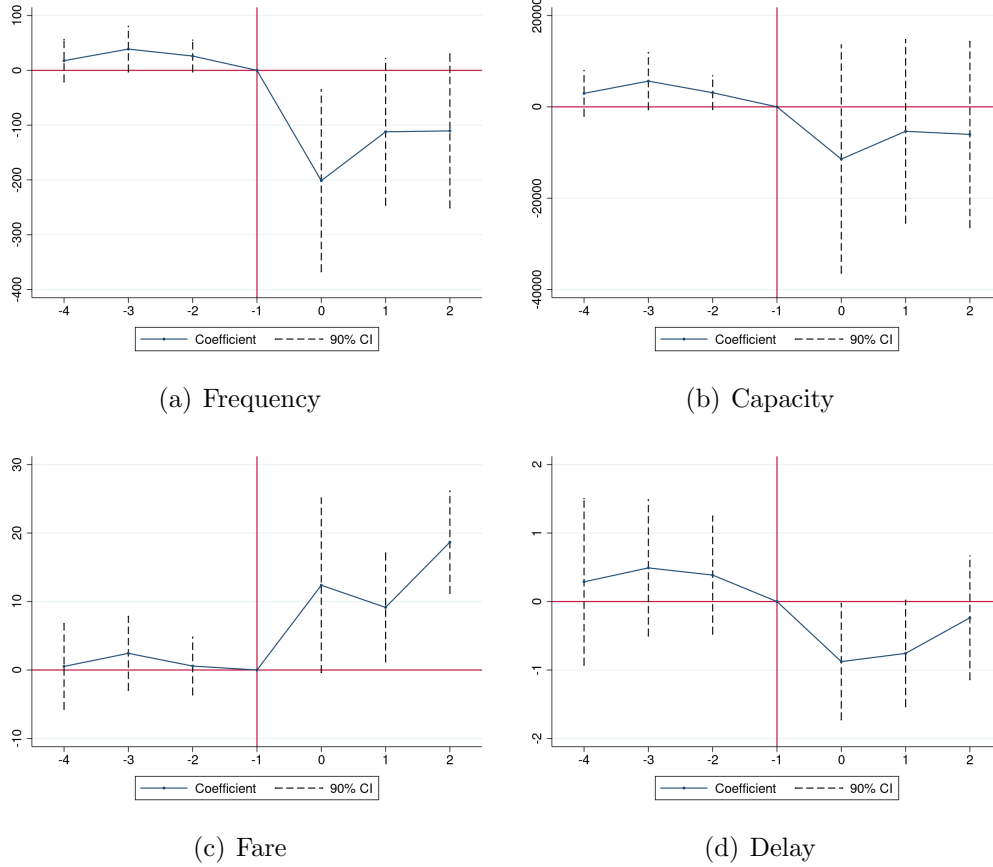


Figure 2: The Dynamic Effect of Airline Exit at the Market Level

Notes: Panels (a), (b), (c) and (d) plot the dynamic effects of regional airline exits on the flight frequency, capacity, average fare and average delay, respectively. Each point (and 90% CI) represents estimates from a regression for each dependent variable. Market-specific and quarter-specific FEs are included. We cluster the standard errors at the market level.

5.1.3 Robustness Checks

Our baseline sample and results incorporate four sample selection restrictions. In this section, we relax each sample selection criterion to assess the robustness of our baseline findings. In panel A, we incorporate flights with one stop, the results align closely with our baseline results because the regional airline-operated markets are predominantly non-stop flights.²⁰

²⁰We also test the impact of including inactive markets and find that the results are insignificant, suggesting that the exits of airlines have a stronger effect on active markets. We have excluded markets with destinations in Alaska, Hawaii, and U.S. territories, as well as those served solely by the exiting airlines, Trans State or Compass Airlines, in our first two restrictions. Since these are all inactive markets, we present results including inactive markets only in the robustness checks.

In panel B, we exclude markets with fewer than one flight per week on average, leaving us with the markets most impacted by airline exits. The results are consistent with our baseline results, but with larger effects of airline exits on outcome variables.²¹ In panel C, we use the market fare in real terms. Specifically, after an airline exits, the market fare in terms of real price increase by 6%, which is consistent with our baseline result. Overall, our results are robust to those alternative sample selection criteria.

Table 5: Robustness Checks

	(1) Frequency	(2) Capacity	(3) Fare	(4) Delay
Panel A: Flights with one stop				
<i>post</i> × <i>treat</i>	−195.138** (88.714)	−15,800 (13585.350)	14.120*** (3.898)	−1.093** (0.480)
R^2	0.848	0.855	0.811	0.707
N	2,814	2,814	2,814	2,814
Mean of Dependent Variables	1,039	107,009	206.0	10.68
Panel B: One flight per week				
<i>post</i> × <i>treat</i>	−199.865** (91.774)	−17,800 (13,932.353)	11.805*** (4.532)	−1.693*** (0.512)
R^2	0.847	0.849	0.802	0.688
N	2,492	2,492	2,492	2,492
Mean of Dependent Variables	1,024	102,387	204.9	10.56
Panel C: Real Prices				
<i>post</i> × <i>treat</i>			0.049*** (0.017)	
R^2			0.809	
N			2,625	
Mean of Dependent Variables			0.767	
Quarter FEs	Yes	Yes	Yes	Yes
Market FEs	Yes	Yes	Yes	Yes

Note: The outcome variables are flight frequency in Column 1, capacity in Column 2, average fare in Column 3 and average delay in Column 4. Panel A reports the results including both nonstop and one-stop flights. Panels B reports the results excluding the markets less than one flight per week on average. Panel C reports the results using the market fare in terms of real price. Both Quarter and Market fixed effects are included in all panels. The standard errors are clustered at the market level. Significance levels are *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

²¹We also test the results of excluding markets with less than two flights per week on average and we find similar results.

5.1.4 Market Heterogeneity

Here we consider two market heterogeneities, namely the distance between the origin and destination of a market as well as the average market share of the exiting regional airlines. The market distance captures two opposing forces in market dynamics. On one hand, the market distance captures the availability of outside options, i.e. driving, bus, and train. A more distant market reduces the attractiveness of outside options, which enhances the market power of incumbent airlines after the exit. On the other hand, the market distance captures the likelihood the market is protected by the EAS program, which subsidizes airlines to provide regular service to eligible communities.²²

Since our sample exiting airlines are contractors for American Airlines, Delta Airlines, and United Airlines, markets with a larger market share of exiting regional airlines relate to a stronger dominance of the largest three FSCs before the exits. Those FSCs can be more aggressive in protecting their markets if they had a larger market share through the exiting regional airlines before the exits. As a result, they may expand their service more after the exits and maintain their dominance in the market.

We present our results of market heterogeneity in panel B of Table 4. In particular, we interact the indicators $post \times treat$ with *Distance* and with *mktshare*. The coefficient on the interaction term with *Distance* is positive and significant in Columns (1) and (2) but negative and insignificant in Columns (3) and (4).²³ Compared to closer markets, the negative effects of regional airlines exit on frequency and capacity are smaller in distant markets. These results are consistent with the policy effects of the EAS program.

Further, the coefficients on the interaction term with *mktshare* are positive and significant in Columns (1) and (2), which indicate that there is a larger increase in the market-level frequency and capacity in the markets with a higher share of exiting regional airlines. In Table A.2, we look into the 6 markets in which the exiting airlines have more than 50% of

²²The Essential Air Service (EAS) program was implemented after the Airline Deregulation Act (ADA) of 1978 to ensure small communities previously served by certificated air carriers continue to receive minimal scheduled air service. A per-passenger subsidy rate is \$1,000 or less if the community is farther than 210 miles from a hub, while the subsidy rate is \$200 or less if the community is farther than 70 miles from a hub.

²³We implement a test on the restriction that the coefficient of $post \times treat$ + the coefficient of $post \times treat \times Distance = 0$, and we cannot reject the null hypothesis. Therefore, the negative effects of the regional airline exits on frequency and capacity cannot be offset by further distance.

market share before their exits. Trans States Airlines present in 5 out of those 6 markets, while the remaining one has Compass Airlines. In those markets, there is another contractor airline, Skywest Airlines (OO), which is also a contractor for all three FSCs. Our results suggest that FSCs utilize the other contractor to preempt the market share of the exiting airlines.

5.2 Airline-Market Level Results

In this section, we study the competitive effects of regional airlines' exits at the airline-market level. Table 6 reports our results. In particular, we estimate the following DiD model:

$$Outcome_{imt} = \alpha post_t \times treat_m + \zeta_{im} + \zeta_t + e_{imt} \quad (4)$$

where $Outcome_{imt}$ represents frequency, capacity, fare, and delay of airlines i in market m in quarter t . We also include airline-market FEs, ζ_{im} , to control unobserved airline-market heterogeneity and quarter FEs, ζ_t , to control aggregate trends in the airline-market outcomes. e_{imt} is the error term. We cluster our standard errors at the airline-market level to allow for serial correlation. According to Hypothesis 2, we expect that α is positive and significant for frequency, capacity, and fare, while α is negative and significant for delay.

5.2.1 Baseline results

Table 6 first shows our baseline results at the airline-market level in panel A. Columns (1) and (2) in panel A indicate that incumbent airlines expanded their flight operations in markets affected by the exits of regional airlines, showing an increase of approximately 105 flights (29% of the mean) and 9,901 capacity (26% of the mean). Columns (3) and (4) report that incumbent airlines increase their prices by 16 dollars (8% of the mean) in markets with the regional airlines exit relative to airlines in the control group, but there is no significant effect on departure delay.

We combine these findings with the results outlined in Section 5.1 and suggest that the incumbent airlines exhibit a preemptive stance in the markets experiencing regional airlines' exits. They augment their flight supplies to seize the market share previously held

by the exiting airlines. Nonetheless, the increased supply from incumbent airlines does not completely offset the loss of service due to the exits. As a result, the more concentrated market structure results in a significantly higher fare, and a weak improvement in service quality if any.

Table 6: Airline-Market Level Models

	(1) Frequency	(2) Capacity	(3) Fare	(4) Delay
Panel A				
<i>post</i> × <i>treat</i>	104.801*** (24.001)	9,901.462*** (3,144.405)	15.709*** (2.950)	−0.822 (0.785)
R^2	0.795	0.837	0.796	0.459
N	6,977	6,977	6,977	6,977
Panel B				
<i>post</i> × <i>treat</i>	−212.760*** (52.281)	−37,500*** (8,228.473)	12.056** (5.696)	−1.314 (1.666)
<i>post</i> × <i>treat</i> × <i>Regional</i>	391.524*** (53.433)	61,132.309*** (7,687.691)	−2.775 (6.239)	−0.498 (1.163)
<i>post</i> × <i>treat</i> × <i>LCC</i>	190.308*** (45.152)	27,352.798*** (7,162.995)	14.670*** (5.626)	1.247 (0.898)
<i>post</i> × <i>treat</i> × <i>Cash</i>	16.903*** (5.545)	1,100.083** (461.036)	2.070** (0.825)	0.584 (0.362)
R^2	0.804	0.850	0.802	0.453
N	6,726	6,726	6,726	6,726
Airline-Market FEs	Yes	Yes	Yes	Yes
Quarter FEs	Yes	Yes	Yes	Yes
Mean of Dependent Variables	358.3	37,433	200.5	11.92

Note: In panel A, we report the baseline results at the carrier-market-year-quarter level. In panel B, we interact the *post* × *treat* variable with airlines' characteristics. We take the log of cash and demean the log of cash. We report the mean values of frequency, capacity, fare, and delay at the airline-market level in the last row. We include airline-market and quarter-fixed effects in both panels A and B. We cluster the standard error at the airline market level. *** p<0.01, ** p<0.05, * p<0.1.

5.2.2 Airline Heterogeneity

In this section, we examine the heterogeneous effects of regional airlines' exits on incumbent airlines' frequency, capacity, pricing, and quality provision. Specifically, we consider if the airline is a FSC, a LCC and/or a regional airline. Relative to LCCs and FSCs, a regional airline is a closer competitor of the exiting regional airlines because they offer more similar products and services. Further, we consider an airline's cash reserves. Financial resources are an important determinant for airlines surviving the COVID-19 pandemic (Standard & Poor Global Market Intelligence 2020). Airlines with more cash are more capable to cover operational expenses, invest in growth opportunities, and navigate unforeseen challenges. Those airlines are expected to have an advantage in expanding their services in the markets with regional airline exits.

Panel B reports the results of airline heterogeneity. The coefficients on the interaction term with *Regional* is positive and significant in Columns (1) and (2), which also more than offset the negative coefficients of $post \times treat$. Incumbent regional airlines increase their frequency by 179 (50% of the mean) and increase their capacity by 23,632 (63% of the mean). The coefficient on the interaction term with *LCC* is positive and significant in Columns (1) and (2), but they do not offset the negative coefficients of $post \times treat$. After the exits, the incumbent regional airlines increase their flight supplies to acquire the passengers from the exiting regional airlines, while incumbent LCCs and FSCs are not keen to do so. At the same time, the incumbent regional airlines keep their fares closer to the pre-exit level to absorb more passengers, while incumbent LCCs and FSCs raise their fares. There are no significant results, however, on on-time performance.

Turning to the airlines with more cash reserves, Columns (1), (2), and (3) report that the coefficients associated with the interaction term involving cash are positive and significant. Airlines with greater cash reserves expand their flight services and increase their fares in the markets experiencing regional airlines' exit. Specifically, if Alaska Airlines' cash reserves are 15% larger than that of Southwest Airlines, it might see a 0.7% (0.4%) increase in frequency (capacity). At the same time, Alaska Airlines charges 0.1% higher price than Southwest Airlines.

In summary, our results suggest that regional airlines are closer competitors to the exiting regional airlines. As a result, the regional airlines' exits generate a more positive demand shift for them, which allows them to increase their services and captures the market share from exiting airlines. They also keep their fares about the same to accommodate the additional passengers. LCCs and FSCs reduce their flight services and raise their fares in response to the exits. Further, airlines with greater cash reserves are more able to increase their market shares and prices after the exits.

6 Conclusion

Our paper examines the competitive effects of regional airline exits on frequency, capacity, pricing, and quality provision in the U.S. The identification of competitive effects comes from the exogenous shock to the survival of Trans States Airlines and Compass Airlines during the COVID-19 pandemic. Based on the combined PSM-DiD model, our empirical analysis leads to several conclusions. First, on average, consumers are worse off after the exits. When a market experiences the regional airlines' exits, there is a significant 16% decrease in flight availability with no immediate replacements and a rise in average fares by roughly 6%. Second, the adverse supply outcome is mitigated for longer-haul markets and markets dominated by FSCs. Third, an analysis of the competition dynamics after the exits indicates that incumbent airlines expand their services and raise their fares. Lastly, competing regional airlines and airlines with greater cash reserves are more able to seize market shares after the exits. Fares rise, but to a lesser extent for competing regional airlines. On-time performance is less impacted by the exits.

Overall, our findings have implications for policymakers in designing effective regulatory and competitive policies for the airline industry in response to the growing concerns with regional airlines' exits. For example, regional airlines currently face an elevated risk of exiting due to pressures associated with pilots retention (Regional Airline Association 2023). Our results suggest that the EAS program offered by the BTS can be effective to offset the adverse impacts on passengers in the affected markets by regional airlines' exits.

From a competition policy perspective, our results also show market shares are more

likely to move among regional airlines rather than between regional airlines and LCCs/FSCs, implying that regional airlines compete in a niche market segment rather than in a broader market with LCCs and FSCs. The results help policymakers gauge the competition level in markets involving regional airlines. Further, although there were a few de novo airline market entries over the last two decades, limited evidence is available to evaluate their competitive effects.²⁴ Our results suggest, however, a potential pro-competitive effects from deregulating entry for regional airlines.

From a managerial perspectives, our results suggest that airline management may find additional value from holding cash reserves. Cash reserves not only provide airlines a financial buffer to overcome economic downturn, our results also show that cash reserves allow airlines to opportunistically respond to competitors' exits. Also, our results suggest that contracting with multiple regional airlines may be a competitive strategy for FSCs to hedge against the risk and maintain their market shares to smaller communities.

Our findings center on the impact of regional airlines that have exited the market, that is, undergone Chapter 7 bankruptcies. An area for future research is to analyze the market and competitive dynamic effects of airlines that have undergone Chapter 11 bankruptcies, having to significantly restructure without exiting the market. A second area for future research would focus on the long term implications of regional airline exits. This study analyzes the first year effects from the COVID-19 pandemic. As airlines and airline markets continue to adjust, analyzing the pandemic's overall effects and long-term implications will add to our understanding of regional airline markets.

²⁴Exceptional cases are Virgin America in 2007, PEOPLExpress in 2014, Avelo and Breeze in 2021.

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Appendix A Appendix Tables

A.1 List of Incumbent Airlines

The incumbent airlines are the airlines had competed with Trans State Airlines and Compass Airlines before they exited. Table A.1 documents a list of 20 incumbent airlines in the markets where the exits occurred. Among them, 7 airlines are LCCs and 11 are regional airlines.

Table A.1: List of Incumbent Airlines

IATA code	Airline Name	LCC	Regional Airline
AA	American Airlines	No	No
AS	Alaska Airlines	No	No
B6	JetBlue Airways	Yes	No
C5	CommuteAir	No	Yes
DL	Delta Air Lines	No	No
EV	ExpressJet	No	Yes
F9	Frontier Airlines	Yes	No
G4	Allegiant Air	Yes	No
G7	GoJet Airlines	No	Yes
MQ	Evory Air	No	Yes
NK	Spirit Airlines	Yes	No
OH	PSA Airlines	No	Yes
OO	SkyWest Airlines	No	Yes
PT	Piedmont Airlines	No	Yes
QX	HorizonAir	No	Yes
UA	United Air Lines	No	No
WN	Southwest Airlines	Yes	No
YV	Mesa Airlines	Yes	Yes
YX	Republic Airlines/Midwest Airlines	Yes	Yes
ZW	Air Wisconsin Airlines	No	Yes

Note: The table lists the IATA codes, names of incumbent airlines in the markets with exits, whether the airline is an LCC, as well as whether the airline is a regional airline. ExpressJet Airlines is not included in the list of regional airlines from [Regional Airline Association](#). However, we still consider ExpressJet Airlines as a regional airline according to [CAPA - Centre for Aviation](#).

A.2 Examples of Treated Markets

Based on Table 2, there are 5 cities serving as an airport hub in our treated sample. Table A.2 lists 13 treated markets connecting Log Angeles (LAX), 11 treated markets connecting Seattle (SEA), and 2 treated markets connecting Los Vegas (LAS) to illustrate our treated markets often connect smaller communities to a hub airport.

Table A.2: Treated Markets connecting to LAX, SEA and LAS

Los Angeles, CA-Albuquerque, NM	Las Vegas, NV-San Jose, CA
Los Angeles, CA-Boise, ID	Las Vegas, NV-San Diego, CA
Los Angeles, CA-Fresno, CA	Seattle, WA-Bozeman, MT
Los Angeles, CA-Houston, TX	Seattle, WA-Boise, ID
Los Angeles, CA-Portland, OR	Seattle, WA-Eugene, OR
Los Angeles, CA-Salt Lake, UT	Seattle, WA-Medford, MA
Los Angeles, CA-Sacramento, CA	Seattle, WA-Portland, OR
Los Angeles, CA-Reno, NV	Seattle, WA-Redmond, OR
Los Angeles, CA-Phoenix, AZ	Seattle, WA-Sacramento, CA
Los Angeles, CA-San Francisco, CA	Seattle, WA-San Jose, CA
Los Angeles, CA-Tulsa, OK	Seattle, WA-Spokane, WA
Los Angeles, CA-San Jose, CA	Seattle, WA-Pasco, WA
Los Angeles, CA-Tucson, AZ	Seattle, WA-Santa Ana, CA

Note: The table lists the treated markets in our data.

A.3 Markets dominated by the Exiting Regional Airlines

Table A.3: List of Airlines in the Markets dominated by the Exiting Regional Airlines

Market	Incumbent Airlines Before Exits	Incumbent Airlines After Exits
Denver city, CO-Springfield, MO	AX, OO	OO
Denver city, CO-Knoxville, TN	AX, G4, F9, OO	YX, OO, G4, F9
Denver city, CO-Great Falls, MT	AX, OO	OO
Denver city, CO-Hayden, CO	AX, OO, G7, UA	OO, WN
Denver city, CO-Minot, ND	AX, OO	OO
Los Angeles city, CA-Tulsa, OK	CP, G4, WN	G4, WN

Note: The table lists 6 treated markets, in which AX or CP holds a market share exceeding 50%. AX is Trans State Airlines and CP is Compass Airlines.