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Disruption in the Skies: A Modern-Day Analysis of Low-Cost and Full-Service Carrier Entry In the Domestic U.S. Market.

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Abstract

This thesis investigates the impact of Low-Cost Carrier (LCC) and Full-Service Carrier (FSC) entry on average airfares over time and at a route level in the domestic U.S markets. Furthermore, this paper investigates the existence of a size effect among the four largest LCCs in the U.S to determine whether the magnitude of the effect depends on the size of the airline that enters the route. Using quarterly data from the first quarter of 2015 until the fourth quarter of 2019, a dataset of 110 routes is analysed using a two-way fixed effects model. This study finds that the entry of an LCC is associated with a significant decrease of airfares by around 10% in the short-run and 8% in the long-run. Conversely, the results suggest that the entry of an FSC is associated with a 3% increase in average airfares in both the short and long-run. In addition, the results also provide some evidence of the existence of a size effect among LCCs, with the largest airline, Southwest, having nearly double the effect on average airfares in all time periods compared to smaller LCCs. However, these results could not be generalized to other LCCs. These findings align with previous literature on this topic, though the magnitude of the effect seems to decrease with modern data. As LCCs continue to decrease airfares upon entry, their effects are becoming less profound, suggesting a potential change in the competitive dynamics of the US airline industry.

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1. Introduction

In the 1990s, flying from Amsterdam to New York would have cost an average individual a small fortune. Nowadays, thanks to Low-Cost Carriers (LCCs) such as JetBlue, the same cross-Atlantic journey can be comparable to half the price of a new iPhone. Furthermore, the inflation-adjusted average airfare for a round trip in the United States (US) decreased from $647.94 in 1990 to $420.70 in 2019 (Picardo, 2023). This drastic decrease can be attributed to the liberalization of the US airline industry and the expansion of LCCs, which made air travel accessible to the broader population, and profoundly disrupted the traditional airline industry.

In the 1980s, LCCs accounted for a minimal market share in the domestic US market. By 1997, LCCs held approximately 13% of the domestic US passenger market, which later mounted to 28% of the domestic passenger market in 2009 (Müller and Hüschelrath, 2013). In the present, the global market size of LCCs in 2024 is estimated to be around $317 billion and is forecasted to grow to $1 trillion by 2032 (Fortune Business Insights, 2024).

The proliferation of LCCs in the US started with the Airline Deregulation Act (ADA) of 1978, which removed all government jurisdiction over airfares, routes, and market entries from the US aviation industry. This act fostered a more competitive and innovative environment which spurred the creation of dozens of new airlines and allowed smaller airlines to expand. During this period, the popularization of the LCC business model, which focused on cost reduction and operational efficiency, became a widespread worldwide. Pioneered by Southwest Airlines, this business model offered lower airfares by operating high frequency, point-to-point, no-frills service flights. As LCCs began to spread, the competition between LCCs and Full-Service Carriers (FSCs) drastically increased. In 1997, only around 13% of the 1000 largest airport-pair routes in the US were operated by both LCCs and FSCs, compared to a 31% route overlap in 2009, forcing FSCs to prioritize operational efficiencies in order to stay afloat (Müller and Hüschelrath, 2013).

Four decades after the Airline Deregulation Act, LCCs continue to disrupt the aviation industry by competing with FSCs more than ever before. The aim of this paper is to understand the ongoing competitive behaviours of LCCs and FSCs on a route level and their influence on market pricing strategies and airfares. This can be summarized with the following research question:

How does the entry of Low-Cost Carriers and Full-Service Carriers affect airfares in the modern-day domestic U.S market, and what role does the size of the carrier have in these effects.

This research is scientifically relevant because it builds upon extensive previous literature which examine the impact of airline entry on airfares. Previous research has consistently found a decrease of airfares associated with the entry of a new competitor, with this decrease being more profound upon the entry of an LCC (Brueckner et al., 2013). Moreover, Malighetti et al. (2013) suggest that while LCCs continue to decrease airfares upon entry, their effects are becoming less profound as competitors have adapted to the ever-changing market conditions over the past decades. Therefore, there is a need to continue the investigation of these trends by using modern-day data and airlines to keep pace with advancements in technology, operational strategies, and changing market conditions. Furthermore, this thesis contributes to previous literature by exploring the existence of a size effect among LCCs on airfares, which investigates whether larger LCCs have an increased magnitude of effect on airfares compared to smaller LCCs. This is a relatively understudied area of the aviation industry and could provide deeper insights into the competitive pricing dynamics of the airline industry.

From a social perspective, the introduction and expansion of LCCs has made air travel more accessible to the broader population through cheaper airfares. Understanding the true extent and nature of these expansions is crucial for policy makers and regulators to maintain a fair and competitive environment, to promote efficiency and innovation, while ensuring the welfare of passengers.

This thesis is structured in the following manner: The following section discusses influential findings of previous literature relevant to this topic. Next, the hypotheses are introduced in the theoretical framework based on economic theory and previous findings. Chapters 4 and 5 discuss the data and econometric techniques used in this research, followed by the results section. Finally, the discussion and conclusion section relate the findings of this paper to previous literature and address the limitations of the models along with suggestions for future research.

2. Literature Review

The following chapter reviews and discusses the most relevant and influential literature related to this research. First, a short overview is given on the history of the United States (US) aviation industry with a focus on the Airline Deregulation Act of 1978, followed by an analysis of previous literature on the impact of low-cost carrier entry on airfares.

2.1. Deregulation of the U.S airline industry

Throughout the early-mid 20th century, the U.S airline industry was heavily regulated by the Civil Aeronautics Board (CAB). The CAB virtually controlled every element of the US aviation industry like a public utility, including airfares, market entries and exits, competition, mergers, and route regulation (Kole & Lehn, 1999). It often regulated which airlines were allowed to fly certain routes and airlines typically competed on service quality rather than airfares. Despite profitability in the industry due to high airfare prices, the aviation industry remained stagnant as profitability masked the economic inefficiencies of growing operational costs and lack of innovation (Aviation week, 2015). Recognizing these inefficiencies and their adverse effects of high airfares on consumers, policymakers advocated for a more free and competitive market.

Ultimately, this transition arrived when the Airline Deregulation Act of 1978 (ADA) was passed, which aimed to create new airlines, increase competition, and decrease airfares (Smithsonian, 2021). The Airline Deregulation Act had a near immediate impact on the aviation industry, leading to a $6 billion annual benefit of consumer welfare, along with an estimated $2.5 billion annual growth of profits within the airline industry, indexed to the 1977 US Dollar (Morrison & Winston 1987). Moreover, airfares in the U.S experienced a 33% drop in the two decades following deregulation (Morrison & Winston 2010).

An important factor in the reduction of airfares post deregulation was the emergence of Low-Cost Carriers (LCCs). Low-Cost Carriers capitalized in the deregulated markets with their innovative business models, which focused on cost-efficiency and competitive pricing models, making air travel more accessible. LCCs such as Southwest, which was only allowed to operate routes within the state of Texas under the CAB regulation period, rapidly expanded operations to interstate routes following deregulation. Southwest's business model, characterized by its no frills service, high aircraft utilization, quick turnaround times, and point-to-point flights, set a new standard for cost-effective operations. Perhaps the most innovative strategy pioneered by LCCs is the unbundling of services from airfares, such as charging separately for extra baggage and on-board meals. This strategy attracted consumers as they only had to pay for the services they used, reducing ancillary costs for passengers, but also increased ancillary revenue for LCCs which significantly contributed to the growth expansion of LCC business models. This forced legacy carriers, or Full-Service Carriers (FSCs), to search for new ways to improve efficiency and reduce operational costs in order to remain competitive.

2.2. Impact of LCC entry

Since the deregulation period, the emergence of low-cost carriers has led to extensive research on their effects on airfares, upon entry into a market. This section reviews previous literature on the impact of LCC entry and its effects on airfare pricing strategies.

This research paper follows a similar structure and addresses a comparable research question to that of Windle and Dresner (1995), who implemented a time-series analysis to investigate the heterogenous effects of entry by LCCs and other carriers on airfares, and whether these effects are sustained over time. Focusing on quarterly data from 1991 to 1994, their results find that increased competition on a route, caused by the entry of a carrier, leads to a 10% decrease of average airfares in the subsequent quarter following entry on that route, with this decrease reaching a peak of 19% in the second and third quarters post-entry. However, their results find that the magnitude of effect is significantly dependant on the carrier that enters. They find that the entrance of Southwest Airlines (LCC) on a route declines average airfares by 48% in the first four quarters upon entry. Their regression analyses support these results and confirm that the entry of Southwest decreases prices more than any other airline including other LCCs such as Morris Air, ValuJet, and Reno Air. Furthermore, the routes Southwest Airlines entered during that period experienced a 300% increase in number of passengers in the first year, compared to a 74% increase in passengers on all other routes which experienced an entry during the time period.

Vowles (2000) employs a regression technique to investigate the variability of average airfares on domestic U.S routes. The regression model controls for important determinants of airfares such as distance and resort destinations. Based on previous research by Goetz (1992) and Borenstein (1989), their model also controls for whether the origin or destination in a city-pair is a hub for any major airline, as well as the market share of the largest carrier on a route; both control variables have been found to have a significantly positive relationship with airfare prices. The author finds that the presence of any LCC on a route decreases average airfares by $45.47, while the presence of Southwest Airlines alone leads to a significantly larger reduction of $77.61, considering the baseline average airfare in the sample to be $170.20.

Whinston and Collins (1992) shifted their focus from the general impact of LCCs or well-known carriers such as Southwest Airlines to the entry impact of a smaller regional carrier in the mid-1980s, People Express. They found that on the 15 routes entered by People Express, mean airfares fell by 34% upon entry during the two-year time period from 1984-1985.

In a more recent study, Brueckner et al. (2013) build on previous research by distinguishing the competitive effects of increased carrier competition between the entry of FSCs and LCCs. Their method also incorporates an overlooked aspect of previous literature by including the indirect effects of increased competition from nearby adjacent airports. For example, they compare the effects of increased route competition from New York's LaGuardia Airport (LGA) to New Orleans (MSY) on airfares to the same destination (MSY) departing from a nearby airport such as Newark Liberty Airport (EWR). They find that the impact of increased competition by FSCs have a minimal effect on the reduction of airfares of 5%, while not having any significant effects on adjacent airport routes. On the other hand, their results show that increased competition by LCCs can lead to average airfare reductions of up to 33%, while also reducing airfares on adjacent airport route of up to 19%.

2.3. Responses of incumbent airlines

Using contemporary data from 1993 to 2014, Kerkemezos et Al. (2022) investigate the competitive responses of established incumbent carriers on monopolistic routes upon the entry of an LCC. They find that LCCs tend to charge fares approximately 5.5% above competitive market rates upon entry. In response, the incumbent carrier significantly lowers their prices not only undercutting the prices charged by the LCC entrant, but by charging 2.8% below the estimated competitive market levels. These results suggest that incumbent carriers may engage in anticompetitive behaviour to deter LCC entry and retain market share on former monopolistic routes, even if that would mean realising potential losses due to aggressive pricing strategies.

Through an in-depth analysis, The Department of Transportation (DoT) claimed that FSCs simultaneously increased prices on short-haul routes where LCCs were not present to compensate for their loss of revenue due to lower airfares on routes with competing LCCs (Windle and Dresner, 1999). However, this is in contrast with economic theory which would suggest that all carriers are rational and aim to always maximize profit on all routes, rather than raising prices on a route to compensate for lower airfares on another route. Windle and Dresner (1999) challenged this claim by investigating the strategic responses of Delta Airlines on competitive and non-competitive routes when a smaller LCC, ValuJet, begins operating routes through Delta's main hub in Atlanta. As expected, Delta Airlines significantly reduced its airfares by around 25% on routes where they faced direct competition (competitive routes) with ValuJet. Contrary to the DoT's claim, no evidence was found to suggest that Delta increased airfares on routes with no direct competition (non-competitive routes) with ValuJet. Their results align with economic theory and show that FSCs adjust airfares based on competitive pressures rather than offsetting costs across their network.

Daraban and Fournier (2008) investigate the short and long run price adjustments strategies of incumbent FSCs in response to entry or exit of LCCs. Furthermore, their research utilizes an autoregressive panel data model to account for spatial dependence among airfares in adjacent airline routes, allowing them to estimate the indirect effects of LCC entry and exit on nearby routes. Based on quarterly data for the period 1993-2006, they first find evidence pointing to anticipatory effects of incumbent airlines. Incumbent airlines begin reducing airfares nearly four quarters prior to entry of an LCC, although this decrease is relatively small as it only accounts for a third of the total price decrease post-entry. Upon entry of an LCC on a route, incumbent airlines significantly reduce their airfares, with the highest reduction being in the quarter after an entry occurs. Furthermore, a significant distinction in magnitude is observed depending on the carrier which enters. Notably, Southwest Airlines exerts the most substantial influence, resulting in nearly double the magnitude of airfare reductions upon entry, when compared to other LCCs. When it comes to post-exit period, they find that the airfare trend is reversed, as incumbent airlines begin to raise prices again. An interesting finding is that upon the exit of Southwest Airlines, incumbents only increase their airfares by about half of the post-entry decrease. While the exit of all other LCCs leads to a full reversal of competitive effects on airfares. Meaning that the entrance and even exit of Southwest airlines, creates a hysteresis effect leading to a new equilibrium of airfare on a route, which is lower than the pre-entry airfare. The results of their spatial autoregressive model suggest that there are spillover effects from the entry of an LCC on a route to adjacent nearby routes, meaning that there are indirect effects of entry. Their SAR model also predicts that the overall welfare benefit of entry by an LCC leads to a 20% reduction in savings of consumers during the analysed period.

Using the expansion patterns of Southwest Airlines, Goolsbee and Syverson (2008) examine how incumbents react to the threat of entry by Southwest before it even starts operating on that route. The authors specifically used the cases of dual airport endpoint presence to establish the threat of entry. This occurs when Southwest commences operations at a second endpoint airport, having already been operating at the first endpoint airport. For example, if Southwest commences operations at Washington Dulles International Airport (IAD) while already having existing operations from Cleveland Hopkins International Airport (CLE), the route between CLE and IAD is considered to have a high threat of entry by incumbents even before Southwest commences direct flights between these two airports. Using quarterly data from 1993-2004, the researchers utilise a probit model to quantify the probability of Southwest commencing service on a given route, based on its presence at endpoint airports. Their results find the incumbents pre-emptively change their pricing strategies, reducing airfares by 17% when Southwest threatens to enter a route before it does. When Southwest ultimately enters that route, fares are further reduced to 21% below the pre-threat period which continue to fall to 29% below the pre-threat fares by the end of the period. This study significantly contributes to previous literature as it provides quantitative evidence that the threat of entry alone can cause price competitive responses from incumbents as a strategy to deter entry.

3. Theoretical Framework

The following section introduces and explains the three main hypotheses of this research paper. Based on previous literature and economic theory, these hypotheses are formulated to aid in answering the main research question. The first two hypotheses aim to address the impact of LCC entry on airfares and the heterogenous effects of entry between LCCs and FSCs on airfares. The final hypothesis investigates whether there are size effects of entry between the observed LCCs.

3.1. Theory of contestable markets

One way to look at the competitive price strategies of airlines is through the contestable markets theory, which was first developed by William Baumol in the early 1980s. The economic concept also translates to the airline industry and states that a market (route) served by a limited number of carriers can still be perfectly competitive if the barriers to enter and exit the market are low (Bailey and Panzar, 1981). This can be seen in a city-pair route market which can be served by only one carrier; however, this carrier must price itself at a competitive cost to prevent price-cutting from potential competitors entering the market (Brock, 1983). If the incumbent carriers in a market do not price themselves competitively, this leaves leeway for new competitors to enter the market and charge lower fares and still earn profits due to lower operating costs. Subsequently, the incumbent carriers must cut airfares or risk losing their market share (Vowles, 2000). This theory is particularly relevant when considering the entry of low-cost carriers as it aligns with pervious findings on the reduction of airfares upon entry of LCCs in a market.

3.2. LCC entry and airfares

As seen in the literature review, previous research suggests that the introduction of low-cost carriers plays a pivotal role in the reduction of airfares on domestic routes in the US. Whinston and Collins (1992) using data from the mid-1980s, found a 34% decrease in airfares upon entry of a low-cost carrier. Windle and Dresner (1999) using data from the 1990s, estimated the price decrease to be up to 25%. While Goolsbee and Syverson (2008) using data from the mid-2000s, found the decline in airfares to be up to 29% following the entry period. These papers, using data from various time periods, persistently found that the entrance of an LCC significantly reduces airfares. When it comes to the entry of FSCs, Brueckner et al. (2013) only observed a slight decrease in airfare prices of 5%, compared to a 33% decrease upon the entrance of an LCC. The airline industry has drastically changed since these papers were published and airlines operate in a more efficient manner nowadays. Therefore, the first set of hypotheses aim to build upon previous research by using modern-day data and airlines:

H1: The entry of a Low-Cost Carrier leads to a reduction of average airfares over time.

H2: The entry of Low-Cost Carriers decreases average airfares more than the entrance of Full-Service Carriers.

3.3. Economies of scale

Economies of scale refer to the cost advantages obtained by larger enterprises, or in this case airlines, due to their larger scales of operations. This occurs when the cost of unit per output decreases as a response to an increase in production, which can be attributed to the spreading of fixed costs over a larger number of units (Antoniou, 1991). In the airline industry, this can be seen as the spreading of the high fixed costs of aircrafts and infrastructure over a larger number of passengers or flights which can significantly decrease the cost per unit. This is particularly relevant when investigating the following topic, as larger airlines may be able to charge lower airfares upon entering a route.

3.4. Size effect

Previous literature agrees that increased competition caused by the entry of an LCC reduces airfare prices. However, the extent of this price reduction varies significantly depending on the specific airline entering the market. Larger LCCs, such as Southwest, tend to have a more substantial impact on the reduction of airfares upon entry compared to smaller LCCs. Windle and Dresner (1995) first observed this through their regression analysis results which found that Southwest reduced airfares to a more profound extent in comparison to other LCCs such as Morris Air, ValuJet, and Reno Air. Subsequently, Vowles (2000) quantified these results by showing that the presence of Southwest Airlines alone decreases prices by $77.61, as opposed to a decrease of $45.47 caused by the entrance of smaller LCCs. Similarly, the investigation of Daraban and Fournier (2008) found a significant distinction between the magnitudes of price reductions among LCCs upon entry, with Southwest having nearly double the effect compared to other LCCs. This leads to the following hypothesis:

H3: Larger Low-Cost Carriers decrease average airfare prices more upon entry compared to smaller Low-Cost Carriers.

4. Data

This chapter details the research design, data collection procedures, and modifications made to the dataset. Thereafter, explanations of the variables used to analyse the impact of airline entry on airfares are provided.

The data used in this paper only considers the available data on the U.S domestic aviation market from the first quarter of 2015 until the fourth quarter of 2019. Route and flight specific data is gathered from the Bureau of Transportation Statistics for all domestic routes within the US through the T-100 Domestic Segment (U.S. Carriers) database. This database contains monthly information reported by certificated U.S. carriers on all their non-stop flight routes, including data on the number of passengers, distance, number of scheduled departures, number of performed departures, seat capacity, and most importantly the number of carriers on a route. Upon gathering all the monthly data for all years between 2015 and 2019, the data is then aggregated into quarters of each year.

Quarterly information on airfares is gathered from the Domestic Airline Consumer Reports, which can be found on the U.S. Airline Consumer Airfare Reports. First made public in June of 1997 by the Department's Office of Aviation Analysis, these reports provide data on the average quarterly prices paid by travellers on the 1000 largest domestic city-pair routes throughout the 48 contiguous states. These non-stop routes make up approximately 49% of all passengers within these 48 states, as well as approximately 47% of all domestic passengers (Domestic Airline Fares Report, 2019). Table 1 of each quarterly report contains data on the average market airfares, number of one-way daily passengers, non-stop distance, as well as the smallest and largest airline by market share on a route. For this research, table 1 of all quarterly reports from 2015 until 2019 were merged making it possible to follow the average airfare prices of each route over time. The prices and routes from the Domestic Airline Airfare reports were then matched to the same route from the T-100 Domestic Segment dataset to observe the change in number of carriers on a route.

To finalize the construction of the dataset, a few adjustments were made. First, to avoid unnecessary data such as cargo airlines, charter airlines, charter flights, private jets, and smaller regional carriers, only the 9 largest domestic US carriers are considered in this research. This may seem to be a small number of carriers, however, the 9 largest carriers in the US made up 90.6% of the US airline market in 2023, when measured by Domestic Revenue Passenger Miles (Domestic RPM) (Bureau of Transportation Statistics, 2023). As seen in table 1, the dataset contains 5 Full-Service Carriers (FSC) and 4 Low-Cost Carriers (LCC) with a minimum market share of 2.3%. To make the dataset more concise, observations with less than 12 scheduled quarterly departures (1 scheduled departure per week) are dropped along with all observations with less than 200 passengers per quarter. This was done under the assumption that airlines with less than 12 scheduled departures, or less than 200 quarterly passengers, on a certain route, do not have enough market power to influence the average airfares on the route.

Table 1: Airlines used in this research.

Airline	IATA Code	Carrier Type	Market Share
Delta	DL	Full-Service Carrier	17.8%
American	AA	Full-Service Carrier	17.3%
Southwest	WN	Low-Cost Carrier	17.2%
United	UN	Full-Service Carrier	16.0%
Alaska	AS	Full-Service Carrier	6.2%
JetBlue	B6	Low-Cost Carrier	5.1%
Spirit	NK	Low-Cost Carrier	3.6%
Frontier	F9	Low-Cost Carrier	3.6%
SkyWest	OO	Full-Service Carrier	2.3%

Source: Bureau of Transportation Statistics, 2023

This research aims to investigate the heterogeneous impacts of entry on airfare prices between Full-Service Carriers and Low-Cost Carriers on a route level. The first step in this process is to determine which routes experienced an entry throughout the 20 quarters from 2015-2019. For an entry to be valid, an airline must enter the route with at least 12 scheduled departures and must stay on that route for at least 3 subsequent quarters post entry, meaning that the airline must stay on the route for at least a year upon entering the market. Since the Domestic Airline Airfare Reports only consider the top 1000 city pairs per quarter in terms of average number of passengers per day, this creates some discrepancies in the data as some city pairs may have a high number of passengers in one quarter but have a much lower number in the subsequent quarters which would mean that it would not be on the list. Considering this, a criterion that an entry must meet is that the route/city pair must have at least 4 quarters of available data prior to the entry and must have at least 4 quarters of available data post entry in order to effectively see the potential fluctuations of average airfares.

Upon filtering for the aforementioned criteria, a sample of the 110 shortest flight routes by distance, which experienced an entry from 2015 - 2019 was constructed. By focusing on the 110 shortest flights by distance, the approach aims to minimize the variation in distance between routes and other constant factors which can significantly impact airfares, ensuring the routes in the dataset are as similar as possible. In those 110 routes, there were a total of 132 airline entries, with 68 LCC entries and 64 FSC entries, more information on this can be found in section 4.3, table 3. The shortest flight route in the dataset is from Portland, Oregon to Seattle, Washington with an air distance of 129 miles, or 1 hour flight time. The longest flight route in the dataset is the route from Austin, Texas to Las Vegas, Nevada with an air distance of 1090 miles, and a flight time of 2 hours and 50 minutes.

4.1. Variables

The following subsections introduce the variables used in this research. To test the impact of airline entry on airfares over time, multiple independent variables have been generated to isolate the effects of FSC and LCC entry in the short and long run. Next, the control variables are motivated and explained along with information on data sources. The descriptive statistics of each of these variables can be found in table 4 under section 4.3.

4.1.1. Dependent Variable

LnAverageprice

This research investigates the impact of airline entry on mean airfares over time. Therefore, the dependent variable is the natural logarithm of the average one-way airfare paid by consumers on a certain route. The airfares include tickets sold by all carriers on those routes, including all first/business class tickets sold by FSCs (Domestic Airline Airfare Report, 2015). The natural logarithm is taken due to the skewness of observations to the left.

4.1.2. Independent Variables

To examine the impact of route entry on average airfares over time, the following variables are created to distinguish the effects of entry between LCCs and FSCs over time. The analyses measure the effects of entry in the quarter of entry, second quarter upon entry, third quarter upon entry, fourth quarter upon entry, and the long run variables measure the effects on airfares until the carrier exits the route or the end of the observed time period.

LCCentry

To determine the immediate effect of entry by an LCC on airfare prices, a dummy variable is created which takes on the value 1 only in the quarter when an LCC enters a certain route and the subsequent quarter, and 0 otherwise. The reason for including the quarter after entry is to account for entries that occurred late in a quarter which may not have a significant effect on average airfares yet. The aim of this variable is to estimate the immediate impact the entrance of an LCC has on average airfares.

FSCentry

A dummy variable which takes on the value 1 only in the quarter when an FSC enters a certain route and the subsequent quarter, and holds the value 0 in all other quarters, for the same reason mentioned prior. This variable aims to determine the immediate impact of entry by an FSC on average airfares.

LCCentry2q and FSCentry2q

These dummy variables measure the effect of entry by an LCC or an FSC in the second quarter upon entry. It takes on the value 1 only in the second quarter after entry, and 0 otherwise.

LCCentry3q and FSCentry3q

Taking on the value 1 only in the third quarter following entry, and 0 otherwise, these variables measure the impact of entry by an LCC or an FSC on airfares three quarters upon entry.

LCCentry4q and FSCentry4q

A dummy variable which takes on the value 1 only in the fourth quarter following entry, and 0 otherwise. They aim to distinguish the effect of entry between LCCs and FSCs in the fourth quarter after entry.

LCClong and FSClong

Finally, a dummy variable which takes on the value 1 from the fifth quarter upon entry and all subsequent quarters, as long as the carrier continues operations on the route. These variables estimate the long-run effects of entry on average airfares by LCCs and FSCs.

4.1.3. Control variables

Number of incumbents

A continuous variable which considers the number of airlines on each route, controlling for the long-run impact of increased and decreased competition on airfare prices. This variable increases by 1 when an airline enters a route and decreases by 1 when an airline exits a route. Increased number of incumbents is negatively associated with average airfares, due to increased competition (Gayle and Wu, 2013).

Exit

A dummy variable which takes on the value 1 only in the year and quarter when an airline on a route exits the market, and 0 otherwise, estimating the immediate impact of reduced competition on a route.

Ln_origin_income and Ln_destination_income

Quarterly per capita state income, adjusted for quarterly inflation rates, was gathered from the Bureau of Economic Analysis (BEA). The per capita incomes were then matched to the origin and destination states of each route. The natural logarithms of both variables are taken due to the observations being skewed to the right. The assumption behind these control variables is that states with higher incomes are less likely to be affected by higher airfare prices. Therefore, a positive relationship with airfares is assumed.

Lgt_mktshare

This continuous variable represents the largest market share owned by a single airline on each route for each quarter. Data on this variable is gathered from each quarterly Domestic Airline Airfare Report. A high market concentration by a single airline would mean that the airline virtually controls most aspects on that route including airfare pricing, so the airline with the largest market share would inflate prices to maximize profits on that route (Borenstein, 1989). Therefore, this variable is assumed to have a positive relationship with airfares.

4.1.4. Controlling for multiple entries on a route

Most routes in the dataset only experience one entry throughout the recorded 20 quarters, however, 22 routes experienced two entries during the reported time period of this research. To control for these exceptions, the following three variables are created:

LCC_LCC

A dummy variable created to account for the entry of a second Low-Cost Carrier on a given route. This variable takes on the value 1 from the quarter and year the second LCC enters the market and holds the value 1 for all subsequent quarters where both airlines are present in the market.

FSC_FSC

A dummy variable created to account for the entry of a second Full-Service Carrier on a given route. This variable takes on the value 1 from the quarter and year the second FSC enters the market and holds the value 1 for all subsequent quarters where both airlines are present in the market.

LCC_FSC

A third variable is created to account for the entry of a different airline type on a route. This variable takes on the value 1 from the quarter and year where the second airline, FSC or LCC, enters the market and holds the value 1 for all subsequent quarters where both airlines are present in the market.

4.1.5. Size effect model variables

The second part of this research paper investigates the heterogeneous effects of entry among different LCCs over time to determine whether a size effect exists. Similar to the previous model, this model estimates the effects of entry for each LCC in the quarter of entry, second quarter upon entry, third quarter upon entry, fourth quarter upon entry, and in the long run. This is done by creating interaction terms of each LCC with the previously mentioned LCC entry variables to isolate the effects of each LCC on average airfares over time. For example, Southwest*LCCentry estimates the immediate effect of entry for Southwest, JetBlue*LCClong estimates the long-run effects of entry for JetBlue. The airlines used in this analysis are listed in table 2 below, along with various size measures in order to rank them by size.

Table 2: Size of low-cost carriers in the dataset

Airline	Revenue	No. of aircrafts	Market share
1. Southwest	$22.4 B	817	17.2%
2. JetBlue	$8.1 B	302	5.1%
3. Spirit	$3.8 B	202	3.6%
4. Frontier	$2.5 B	147	3.6%

Note: The table shows how the LCCs used in this research vary by size. Revenue and number of aircraft data was gathered for the year 2022, which are identical to the pre-COVID measures.

4.2. Descriptive statistics

Table 3: Entries of each airline and total entries

Airline	Number of entries
Delta	15
American	15
United	14
Skywest	13
Alaskan	7
Southwest	19
JetBlue	9
Frontier	23
Spirit	17
Total FSC entries	64
Total LCC entries	68
Total airlines entries	132

Table 4: Descriptive statistics of all variables used in the main model.

Variable	Observations	Mean	Std. Dev.	Min	Max
AveragePrice	2,192	192.887	45.827	113	382
LnAveragePrice	2,192	5.236	0.226	4.727	5.945
Number of incumbents	2,192	2.147	1.414	0	7
Ln_origin_income	2,192	10.797	0.123	10.531	11.195
Ln_destination_income	2,192	10.853	0.149	10.566	11.339
Lgt_mktshare	2,192	0.586	0.154	0.26	1
LCCentry	2,192	0.062	0.239	0	1
FSCentry	2,192	0.058	0.233	0	1
LCCentry2q	2,192	0.031	0.173	0	1
FSCentry2q	2,192	0.029	0.167	0	1
LCCentry3q	2,192	0.031	0.172	0	1
FSCentry3q	2,192	0.029	0.167	0	1
LCCentry4q	2,192	0.031	0.172	0	1
FSCentry4q	2,192	0.029	0.167	0	1

LCClong	2,192	0.142	0.348	0	1
FSClong	2,192	0.146	0.353	0	1
LCC_LCC	2,192	0.011	0.104	0	1
FSC_FSC	2,192	0.006	0.077	0	1
LCC_FSC	2,192	0.019	0.139	0	1

5. Methodology

This chapter focuses on the methodological approach and econometric techniques used to tackle the main research question and test the hypotheses mentioned in the theoretical framework. To do so, two models are used incorporating all the variables mentioned in the previous section. Inspired by the methodological approaches of Windle and Dresner (1995), and Goolsbee and Syverson (2008), both papers estimate the impact of low-cost carrier entry on airfare prices over time. Similar to their seminal work, both estimating equations in this analysis implement time-quarter fixed effects along with route fixed effects to control for unobservable time-invariant omitted variables and temporal variability.

As explained by Allison (2009), fixed effects models assume that confounding factors that may be missing in this dataset that affect both the independent and dependent variables are in general constant over time. Implementing route fixed effects allows the model to control for unique route characteristics which are constant over time but may vary across routes. The paper published by Borenstein (1989) highlights important confounders omitted from this research such as distance, tourist destinations, and whether one of the endpoints on a route is a hub of a major airline. Given that these confounders are likely to remain constant throughout the investigated period, the fixed effects model already effectively controls for these variables, reducing the probability of omitted variable bias. Implementing year-quarter fixed effects allows the model to control for macroeconomic trends, seasonality, and other temporal variations that may influence airfares on all routes. Moreover, the inclusion of year-quarter fixed effects isolates the impact of LCC entry on airfares, enhances the robustness of the results, reduces potential endogeneity issues, and further reduces omitted variable bias by controlling for time-varying confounders (Bell and Jones, 2014).

The first model aims to estimate the heterogeneous effects of FSC entry and LCC entry on average airfares over time. By including a series of dummy variables, the model accounts for the variability of average airfares in the post-entry period by exploring the immediate effects of entry, short-run effects, and long-run effects for both LCCs and FSCs. Furthermore, the model controls for potential time-varying confounders such as the number of incumbents on a route, per capita income at the origin and destination states on a route, the market share of the largest carrier, and the entrance of a second competitor during the period. Furthermore, the model includes route fixed effects on route i, denoted γ_i, along with year-quarter fixed effects at time t, denoted by δ_t. This results in the following estimating equation for model 1:

$$(1)\quad \ln(Averageprice_{i,t}) = \alpha + \beta_1 LCCentry_{i,t} + \beta_2 FSCentry_{i,t} + \beta_3 LCCentry2q_{i,t} + \beta_4 FSCentry2q_{i,t} + \beta_5 LCCentry3q_{i,t} + \beta_6 FSCentry3q_{i,t} + \beta_7 LCCentry4q_{i,t} + \beta_8 FSCentry4q_{i,t} + \beta_9 LCClong_{i,t} + \beta_{10} FSClong_{i,t} + \beta_{11} Numberofincumbents_{i,t} + \beta_{12} Exit_{i,t} + \beta_{13} \ln(origin\_income_{i,t}) + \beta_{14} \ln(destination\_income_{i,t}) + \beta_{15} Lgt\_mktshare_{i,t} + \beta_{16} LCC\_LCC_{i,t} + \beta_{17} FSC\_FSC_{i,t} + \beta_{18} LCC\_FSC_{i,t} + \gamma_i + \delta_t + \epsilon_{i,t}$$

All the hypotheses mentioned in section 3 are tested using joint F-tests to determine the joint significance of a group of variables, or the difference between two groups of variables. The resulting F-statistics and p-values will be discussed in the results section. A p-value < 0.05 would indicate that the group of variables, or differences between groups of variables are statistically significant and differ from 0. In addition, individual t-tests using the "lincom" function in Stata are utilized to examine the significance of each coefficient or the difference of coefficients and interpret the sign. The respective results of the t-tests are displayed in the appendix but are discussed in the results section.

Hypothesis 1 is tested using a joint F-test to determine if the joint-significance of all LCC entry variables statistically differ from zero. Furthermore, individual t-tests are conducted for each LCC entry variable to determine if the coefficients obtained from the regressions are statistically significant over time.

To test the second hypothesis of this paper; first, a joint F-test is employed to evaluate whether the differences between the coefficients of LCC entry and FSC entry are statistically different from zero across all time periods following entry. Next, a series of t-tests, are conducted to determine the sign of the difference across all time periods. This is again done by taking the difference between the coefficients of LCC entry and FSC entry for each period upon entry. If the t-tests show a negative coefficient which is statistically significant, this would support the hypothesis that LCCs decrease airfare more upon entry when compared to FSCs.

When it comes to the second part of this research, which investigates the heterogeneous effects of entry among LCCs on airfares and the potential existence of a size effect, a similar econometric model is used. Coefficients β_1 to β_5 capture the immediate, short-run, and long-run impacts of entry by LCC a, on route i, at time t. This model controls for the same confounding factors as mentioned in the previous model. Finally, this model also employs route fixed effects, denoted γ_i , along with year-quarter fixed effects, denoted by δ_t. This results in the following estimating equation for model 2:

$$(2)\ \ ln(Averageprice_{i,t}) = \alpha + \beta_1 Entry_{a,i,t} + \beta_2 Entry\_2q_{a,i,t} + \beta_3 Entry\_3q_{a,i,t} + \beta_4 Entry\_4q_{a,i,t} + \beta_5 Entry\_long_{a,i,t} + \beta_6 Numberofincumbents_{i,t} + \beta_7 Exit_{i,t} + \beta_8 ln(origin\_income_{i,t}) + \beta_9 ln(destination\_income_{i,t}) + \beta_{10} Lgt\_mktshare_{i,t} + \gamma_i + \delta_t + \epsilon_{i,t}$$

The third and final hypothesis is tested in a similar manner as the previous hypothesis. It is important to note that the largest LCC in the dataset is Southwest, followed by JetBlue, Spirit, and Frontier (*Table 2*). Three joint F-tests are conducted to determine whether the differences between the resulting coefficients of each airline statistically differ from zero. Following the joint F-tests, a series of individual t-tests are conducted to infer the sign of the differences between the LCCs for each time period. If the coefficient attained from the t-test is significant and negative for each test, this indicates that larger LCCs reduce airfares more than smaller LCCs.

6. Results

This section of the paper showcases and explains the main statistical findings of the models explained in the previous section. By isolating the effects of entry between low-cost carriers and full-service carriers, the results displayed in Table 5 estimate the heterogenous effects of entry between the two airline types on airfares over time, which will be used to address the first two hypotheses of this research paper. Subsequently, further analysis is done to differentiate the effects of LCC entry on airfares between all 4 LCCs found in the dataset. This analysis aims to address the third and final hypothesis which suggests that the magnitude of effects differ depending on the size of the LCC that enters a route.

6.1. Effects of entry on airfares

Table 5 below presents the results of the fixed effects model aimed at investigating the impact of airline entry on average airfares on domestic US routes. The dependent variable for both columns is the natural logarithm of the average one-way airfare price (LNAveragePrice), while the independent variables measure the effects of entry for LCCs and FSCs over time. Column 2 includes controls for the entrance of a second carrier on a route during the period. While both analyses estimate identical findings, the second column has a higher explanatory power (R^2) of 36.5%, therefore the main findings will be interpreted using column 2.

6.1.1. Immediate impact of entry on airfares

The results indicate an immediate impact of entry on mean airfares for both LCCs and FSCs, significant at 1% confidence level. Increased competition caused by the entrance of a low-cost carrier is associated with a decrease in average airfares on a route. The variable LCCentry attains a coefficient of -0.089, translating to an 8.9% decrease in average airfares on a route in the quarter of entry and the following quarter. Conversely, the entrance of a FSC is associated with a slight increase of average airfares. The results suggest a modest 3.5% increase in airfares immediately upon the entry of a FSC on a route.

6.1.2. Short-run effects of entry on airfares

The model further explores the short-run effects of entry. By taking into consideration the impact of entry in the second, third, and fourth quarters upon entry, the model effectively estimates whether the immediate decrease/increase of airfares found is sustained throughout the first year of entry.

When it comes to the second quarter following entry, variables LCCentry2q and FSCentry2q are considered. The coefficient of -0.112 for LCCentry2q is statistically significant at a 1% confidence level. This suggests that airfares decrease to 11.2% below the pre-entry fares, reaching its peak two quarters upon the entrance of an LCC. FSCentry2q, significant at a 10% level, has a coefficient of 0.029 indicating a decline in the increase of airfares to a level of 2.9% in the second quarter following the entrance of an FSC.

Looking at the third quarter post entry, the results of the LCCentry3q variable, significant at a 1% level, suggest that airfares fall to 9.1% below the pre-entry price level. The coefficient measuring the airfare fluctuation upon the entry of an FSC is not statistically significant for this quarter.

Furthermore, the results indicate that the decline of average airfare prices is still persistent and significant at a 1% level in the fourth quarter upon entrance of an LCC, indicating a decrease of 8.6% compared to pre-entry levels. On the other hand, the entry of an FSC seems to increase prices by 3.3% compared to the baseline level in the fourth quarter following entry.

6.1.3. Long-run effects of entry on airfares

Investigating the long-run effects of airline entry on airfares entails estimating the fluctuations of airfares from the fifth quarter upon entry and all subsequent quarters, as long as the airline continues operations on the route. The LCClong variable, significant at a 1% level, indicates that the continuous presence of an LCC reduces airfares by approximately 8.1% below the pre-entry level, in the long-run. In contrast, the entry of a FSC is associated with a minimal increase in average airfare prices. Measured by the FSClong variable, which is significant at a 5% level, the results suggest a slight increase in airfares of 3% in the long-run.

In summary, the entrance of a low-cost carrier on a route has a consistently significant and negative effect in all periods. However, the results indicate a variation in the magnitude of airfare reductions over time following the entry of an LCC. With the initial 9% decrease immediately upon entry increasing and peaking at around 11.2% in the second quarter following entry, before stabilizing at approximately 8.1% below the pre-entry levels in the long run. When it comes to the effect of entry by FSCs, the results indicate a contrasting effect compared to the entry of LCCs. With an immediate marginal increase in average airfare prices upon entry, which remains relatively stable over time at around 3%.

6.2. Testing hypotheses 1 and 2

The first hypothesis investigates the negative relationship between LCC entry and airfares over time. The joint F-test results in an F-statistic of 12.72 and a p-value < 0.001, indicating that the joint significance of all obtained LCC entry coefficients significantly differs from zero. Moreover, all individual t-tests show that each coefficient is negative and statistically significant. This provides enough support to reject the null of the first hypothesis and conclude that LCC entry reduces airfares over time.

Hypothesis 2 states that LCCs reduce airfares more than FSCs upon entry. The result of the joint F-test, with an F-value of 41.23 and a p-value < 0.001, indicates that the differences between the coefficients of LCC and FSC entry are statistically significant and differ from zero. Subsequent individual t-tests, found in table 9 under appendix B, confirm a negative difference with statistically significant coefficients in each test. These findings suggest that low-cost carriers contribute to a larger reduction of airfares in all periods following entry compared full-service carriers. This provides enough support to reject the null of the second hypothesis.

Table 5: Fixed effects regressions estimating the impact of airline entry

Variables	**(1) LNAveragePrice**	**(2) LnAveragePrice**
LCCentry	-0.090*** (0.013)	-0.089*** (0.013)
FSCentry	0.034*** (0.013)	0.035*** (0.134)
LCCentry2q	-0.112*** (0.016)	-0.112*** (0.016)
FSCentry2q	0.028* (0.016)	0.029* (0.016)

LCCentry3q	-0.096*** (0.016)	-0.091*** (0.016)
FSCentry3q	0.025 (0.016)	0.026 (0.016)
LCCentry4q	-0.086*** (0.015)	-0.086*** (0.025)
FSCentry4q	0.029* (0.016)	0.033** (0.017)
LCClong	-0.080*** (0.013)	-0.081*** (0.014)
FSClong	0.027** (0.013)	0.030** (0.014)
Exit	-0.019 (0.025)	-0.013 (0.025)
Number of Incumbents	-0.075*** (0.009)	-0.074*** (0.009)
LNorigin_income	0.823*** (0.190)	0.819*** (0.191)
LNdest_income	-0.098 (0.170)	-0.109 (0.170)
Lgt_mktshare	-0.035 (0.030)	-0.034 (0.030)
LCC_LCC		-0.002 (0.024)
FSC_FSC		-0.030 (0.031)
LCC_FSC		-0.040** (0.018)
Constant	-2.305 (2.596)	-2.137 (2.596)
Time fixed effects	Yes	Yes
Route fixed effects	Yes	Yes
N	2192	2192
R2	0.357	0.365

Note: The brackets below the coefficients indicate the robust standard errors. * for p ≤ 0.10,** for p ≤ 0.05, and *** for p ≤ 0.01, significance levels. N is the total number of observations which are clustered on a route basis.

6.3. Size effect

To investigate the heterogenous effects of entry by different sized low-cost carriers on average airfares, the results of the second model which are displayed in table 7 are interpreted. The model isolates the effects of entry on average airfares over time of the four LCCs used in the dataset. As seen in Table 3 of section 4.1.5, these LCCs are ranked by size to determine whether the magnitude of effect varies depending on the size of the LCC. The largest LCC in the dataset is Southwest Airlines, the second largest is JetBlue Airways, while Frontier and Spirit airlines are the smallest LCCs in the dataset. The independent variables are interpreted identically as the previous model, with each airline's impact on airfares being estimated for the quarter of entry, second quarter upon entry, third quarter upon entry, fourth quarter upon entry, and in the long run.

Graph 1 below portrays the main findings of the model in table 7 along with their respective 95% confidence intervals. When it comes to the entry of LCCs, the magnitude of effect seems to depend on the airline that enters. The graph below illustrates that the entrance of a larger LCC, such as Southwest Airlines, leads to a substantial decrease of airfares compared to smaller LCCs such as JetBlue and Frontier.

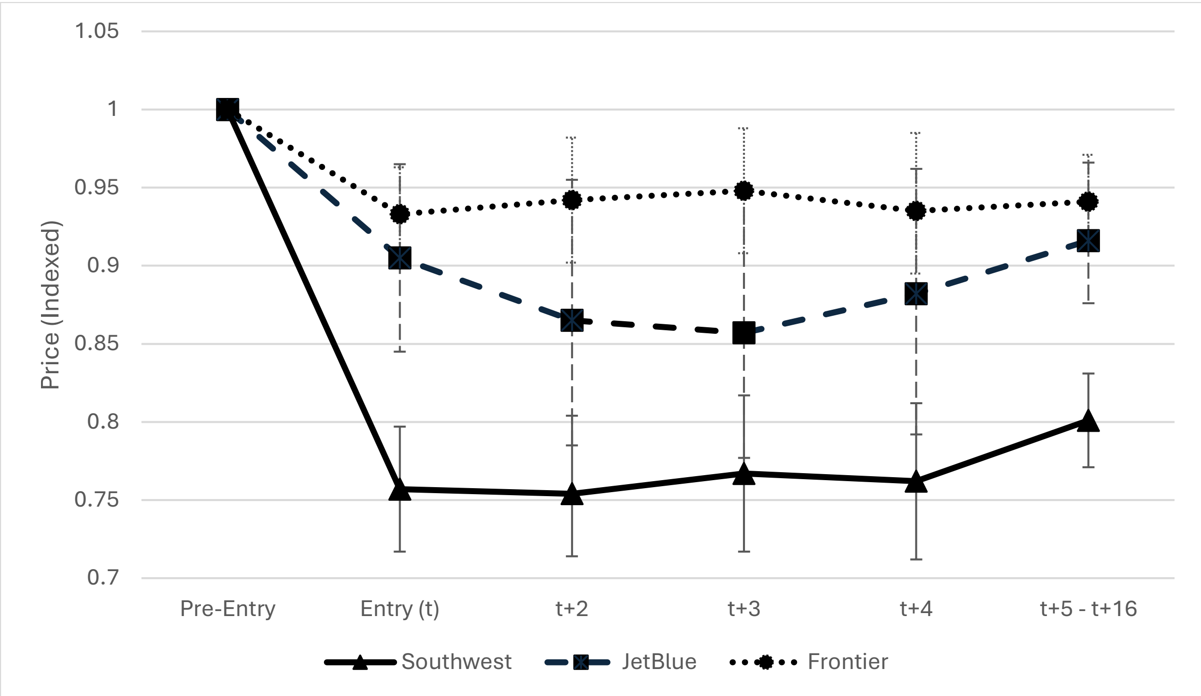

Figure 1: Post-entry price variability index of different LCCs

Note: The figure displays the decrease of airfares over time following entry of different-sized LCCs. The Y-axis measures the change in average airfares on a route, while the X-axis shows the immediate, short-run, and long-run changes. The 95% confidence interval is displayed for each observation.

Looking at the results of table 7, the first five rows entail the price reductions associated with the entrance of Southwest Airlines. Upon entry, airfares immediately reduce by a staggering 24.4%, followed by a decrease and peak of 24.6% in the second quarter upon entry, before stabilizing and reaching a new airfare equilibrium in the long run at 19.9% below the pre-entry level airfares. When considering the entrance of a smaller LCC, JetBlue Airways, the magnitude of reduction is nearly halved compared to Southwest. Airfares are reduced by a modest 9.5% immediately upon the entry of JetBlue, the magnitude to increases to 14.3% reaching its peak in the third quarter upon entry and stabilizes in the long run at 8.4% below the pre-entry airfares. The smallest LCC in the dataset, Frontier Airlines, only reduces airfares by around 6.7% hitting its peak immediately upon entry. The impact remains relatively constant at around 5%-6% in the short term, until stabilizing in the long run at 5.9% below pre-entry level airfares. The results of Spirit Airlines are not statistically significant apart from a 3.7% decrease of airfares in the second quarter following entry.

6.4. Testing hypothesis 3

Finally, hypothesis three examines whether larger LCCs are associated with a larger reduction of airfares upon entry when compared to smaller LCCs. The results of the joint f-tests indicate that the difference of entry coefficients between Southwest and JetBlue; and Southwest and Frontier are statistically different from zero in all periods. In contrast, the joint F-test comparing the coefficients of JetBlue and Frontier yields a p-value of 0.261, indicating that there are no statistical differences between their impacts on airfares over time. The subsequent individual t-tests, found in appendix C, indicate that the entry of Southwest Airlines is associated with a larger reduction of airfares in all periods upon entry when compared to smaller LCC, such as JetBlue and Frontier, as the coefficients of the differences are negative and statistically significant at a 5% confidence level for all periods. However, the existence of a size effect cannot be determined with certainty between JetBlue and Frontier, as both the joint F-test and t-tests display insignificant results meaning that we cannot fully support the third hypothesis. These findings indicate that a size effect may only exist for Southwest, therefore we cannot reject the null of the third hypothesis which states that larger LCCs decrease airfares to the same extent as smaller LCCs upon entry.

Table 6: Joint F-test results examining the difference of coefficients between a larger and a smaller LCC.

Variables of Interest	**F-statistic**	**p-value**	**Degrees of Freedom**
Southwest – JetBlue = 0	6.25	< 0.001	(5, 2038)
Southwest – Frontier = 0	28.09	< 0.001	(5, 2038)
JetBlue – Frontier = 0	1.30	0.261	(5, 2038)

Table 7: Fixed effects model estimating the size effect of entry by different LCCs.

Variables	**LNAveragePrice**

SouthwestEntry	-0.243*** (0.018)
SouthwestEntry_2q	-0.246*** (0.024)
SouthwestEntry_3q	-0.233*** (0.024)
SouthwestEntry_4q	-0.238*** (0.024)
SouthwestEntry_long	-0.199*** (0.014)
JetBlueEntry	-0.095*** (0.033)
JetBlueEntry_2q	-0.135*** (0.044)
JetBlueEntry_3q	-0.143*** (0.043)
JetBlueEntry_4q	-0.118*** (0.044)
JetBlueEntry_long	-0.084*** (0.024)
FrontierEntry	-0.067*** (0.015)
FrontierEntry_2q	-0.058*** (0.019)
FrontierEntry_3q	-0.052*** (0.019)
FrontierEntry_4q	-0.065*** (0.021)
FrontierEntry_long	-0.059*** (0.013)
SpiritEntry	-0.011 (0.017)
SpiritEntry_2q	-0.037* (0.023)
SpiritEntry_3q	-0.026 (0.023)
SpiritEntry_4q	-0.008 (0.026)
SpiritEntry_long	0.009 (0.015)
Number of Incumbents	-0.063***

	(0.006)
Exit	-0.002 (0.023)
LNorigin_income	0.729*** (0.184)
LNdest_income	-0.368** (0.166)
Lgt_mktshare	-0.025 (0.029)
Constant	1.592 (2.520)
Time Fixed Effects	Yes
Route Fixed Effects	Yes
N	2192
R2	0.402

Note: The brackets below the coefficients indicate the robust standard errors. * for p ≤ 0.10, ** for p ≤ 0.05, and *** for p ≤ 0.01, significance levels. N is the number of observations which are clustered on a route basis for this analysis.

7. Discussion

The following section reviews and discusses the main findings of this paper and relates them to the findings of previous studies. Subsequently, the main strategic and policy implications are discussed based on the results. This section is concluded by acknowledging the limitations of the models, followed by suggestions for future research.

Extensive research has already been conducted on the impact of LCC entry on airfares since the Airline Deregulation Act of 1978. This paper adds on to previous literature by making use of modern-day data and airlines, making this research highly relevant for pricing strategies of today's U.S domestic market.

The first part of this research investigated the impact of airline entry on average airfares on a route level, and the heterogeneous effects of LCC and FSC entry. The regression results find that the entrance of an LCC is associated with a significant and negative effect on average airfares in all time periods following entry. An immediate decrease of 8.9% is observed, which increases and peaks at 11.2% below pre-entry level airfares in the second quarter following entry, before stabilizing and finding a new route equilibrium in the long run where airfares are around 8% lower than the pre-entry airfares. Furthermore, the regression results are supported by the results of the first F-test and t-tests, which statistically confirm the negative effects of LCC entry on airfares in all post-entry periods and provide evidence to reject the null of the first hypothesis.

These findings align with the theory of contestable markets and mostly support previous literature; however, the magnitude of effect seems to differ slightly. For example, Whinston and Collins (1992) found that airfares decline up to 34% in the quarters following the entry of an LCC, while Windle and Dresner (1999) found the decrease to be up to 25%. Goolsbee and Syverson (2008) found an immediate decrease of 21% upon entry which increases to 29% in the short run period of their analysis.

When it comes to the entrance of FSCs, the model estimates an increase of airfares by approximately 3% which remains constant over time. These results, on the other hand, contradict previous research done by Windle and Dresner (1995) and Brueckner et al. (2013), who found FSC entry to decrease airfare prices by around 5% upon entry. A plausible explanation for the discrepancy in findings lies in the nature of the dataset. Considering that the Domestic Airline Consumer Reports only publish data for the top 1000 routes in terms of passengers, most of the routes operated in these reports connect two large airports, which are usually used as hubs for large FSCs. FSCs often leverage their dominance on routes connecting through their hubs by charging higher fares (Alderighi et Al., 2016). In simple terms, if an FSC enters a route where one of the endpoints is their hub, the FSC usually charges a higher airfare on these routes, which could explain the 3% increase of airfares upon entry found in this paper. Testing the second hypothesis of this paper provides enough evidence to conclude that the entry of an LCC exerts more downward pressure on average airfares in all observed periods following entry compared to FSCs, which is in line with previous literature (Windle and Dresner, 1995; Brueckner et. Al, 2013).

Most previous studies investigating the impact of airline entry on airfares have been conducted using data from the three decades following the Deregulation Act of 1978. This paper adds on to previous research by using recent data and clearly distinguishing the effects of LCC and FSC entry across several periods upon entry. Furthermore, a significant change in the magnitude of effect is observed when compared to previous research. While LCCs continue to decrease airfares upon entry, their effects are becoming less profound, suggesting a potential change in the competitive dynamics of the US airline industry. As LCCs continue to expand, FSCs turn their focus towards operational efficiencies, cost-cutting measures, and more competitive pricing strategies than ever before, decreasing the gap to LCCs in terms of pricing (Brueckner et Al., 2013). As markets mature over time and LCC expansion becomes more prevalent, the relative price differentials between LCCs and FSCs decrease and converge as legacy carriers become more accustomed to low-cost carrier business models, leading to smaller changes of airfares upon the entrance of an LCC (Morisson, 2001). Moreover, the findings of this paper indicate the increased commoditization of air travel in recent years, as LCC and FSC business models converge, price becomes the primary competitive factor among airlines to accommodate increasingly price-sensitive consumers on short-haul flights (Granados et Al., 2012; Padilla, 2014)

The second part of this research investigated the heterogeneous effects of entry among the four largest LCCs in the US and whether a size effect may exist. The results obtained from the second model find that the entry of the largest LCC, Southwest, reduces airfares by approximately 20%-25% in both the short and long run. This is a drastic decrease when compared to the second largest LCC in the dataset, JetBlue, who reduces airfares by around 11%-14% upon entry. The smallest LCC in the dataset, Frontier, only reduces prices by around 5%-6% which remains constant throughout the studied period. The regression results suggest the existence of a size effect among the observed LCCs. However, further analyses indicate that the existence of a size effect may only be concluded for Southwest Airlines.

When testing for the third hypothesis, the results obtained while investigating the difference of coefficients between the impact of JetBlue and Frontier were found to be statistically indifferent from 0. In contrast, Southwest was found to have a significantly larger impact on airfares when compared to JetBlue and Frontier. This indicates that while JetBlue generally has a larger impact than Frontier on airfares from the regressions' results, the evidence is not strong enough to conclusively state that JetBlue, as a larger airline, reduces airfares significantly more than Frontier upon entry. One reason for this could be the limited number of JetBlue entry observations in the dataset, with only 9 observations, which may have hindered the model's ability to accurately estimate the true variation in airfares, compared to other LCCs which entered nearly 20 routes each during the observed period. This means that we cannot fully accept the third hypothesis due to the lack of statistical significance. Therefore, while the overall trends of the regression may indicate that larger LCCs decrease airfares more upon entry, this is primarily driven by the significant impact of Southwest Airlines, while the evidence is less clear when comparing other LCCs.

These findings suggest that the role of size effects in the reduction of airfares are only significant for particularly large LCCs such as Southwest. Moreover, Southwest controls 17.2% of the domestic US market and generates three to seven times more revenue than its nearest LCC competitors, JetBlue and Frontier (table 2). Perhaps this indicates that the benefits of a size effect emerge once a certain threshold of market share and revenue is obtained, implying that only the largest LCC can exert considerably larger competitive pressures on airfares upon entry. Further research is needed to investigate these implications and determine the existence of a size effect among other LCCs.

These results partly backup previous findings of Windle and Dresner (1995), Vowles (2000), and Daraban and Fournier (2008), who all found that the entrance of Southwest Airlines has nearly double the effect of decrease compared to smaller U.S low-cost carriers. However, there are no studies done that specifically explore the existence of size effects among LCCs and their impact on airfares, making this paper highly relevant by contributing to this relatively understudied aspect of the industry. These findings provide significant insights into the complex dynamics of airline competition and provide deeper explanations of the pricing strategies in the airline industry, which should be further explored.

To answer the main research question, this paper finds that increased competition attributed to the entry of an LCC, is associated with a significant immediate decrease of airfares upon entry, which is sustained in the short and long run. On the other hand, we find that the entrance of an FSC is significantly associated with a slight increase in airfares. We find some evidence to suggest that a size effect may exist among LCCs, especially when considering Southwest, however the lack of statistical significance when looking at JetBlue and Frontier hindered the acceptance of the final hypothesis.

7.2. Strategic Implications

The main findings of this research provide a basis for various strategic and policy implications. Firstly, in the event of LCC entry, average airfares on that route are bound to decrease, therefore, FSCs must develop an efficient pricing strategy that can rapidly adjust to market entries to remain competitive and retain market share. Moreover, depending on the airline that enters the market, incumbent airlines can use these results as an estimate to adjust their financial forecasting to account for potential losses or gains on routes with expected entry, improving the financial health of airlines. Given that FSCs have a minimal impact on airfares upon entry due to their high operating costs, it is important for FSCs to focus on superior service quality and customer experiences to justify higher price points and maintain customer loyalty to competing LCCs.

The main policy implication which can be deducted from this research is that policies should encourage the creation and expansion of LCCs, as this leads to a more competitive market with lower airfares. This could be done by ensuring equal gate and slot availability at larger airports or by offering these slots at a discounted rate for smaller LCCs (Vowles 2000). Furthermore, regulators should enhance the overall competitive aspects of the aviation industry. For example, stricter antitrust regulations should be put in place to prevent predatory and monopolistic pricing and ensure fair competition.

7.3. Limitations and suggestions for further research

Even though this research provides valuable insights into the pricing dynamics of airline types and airline sizes within the U.S domestic market, several limitations of the models must be acknowledged.

Recognizing these limitations is crucial when it comes to interpreting the results and guiding future research. The primary limitations of this research stems from the small sample size of 110 routes, short period of 5 years, and the omission of smaller carriers.

To minimize the variation of constant factors between routes, the sample size used in this research is relatively small as only the 110 shortest routes which experienced an entry were used. The results obtained in this small sample may not apply to other routes that are not included; therefore, future research should incorporate a larger and more diverse sample to improve the validity of results.

With the ever-changing dynamics of the aviation industry, previous literature has shown that the impact of airline entry on airfares seems to be reducing over time (Malighetti et Al, 2013). It is important for future research to consider a broader time frame and follow how these trends have evolved.

This research only considers the nine largest carriers in the domestic U.S market making up 90.6% of the market share. The exclusion of smaller carriers, which may have different operational dynamics, could bias the results if smaller carriers influence the variability of airfares on these routes. Especially considering the rising popularity of the Ultra Low-Cost Carrier (ULCC) business model, which has the potential to decrease airfares more than LCCs.

Furthermore, it is important to note that the findings of this paper only relate to short-haul flights in the domestic US market. Future research should also investigate and compare the competitive dynamics of LCC and FSC entry in other regions, such as the European and Asian markets, as these markets may have different regulatory environments, competition levels, market structures, and consumer behaviours. This would provide valuable insights on competitive and pricing dynamics of the airline industry on a global scale.

Given the nature of the Domestic Airline Consumer Reports which only consider the top 1000 airline route in terms of quarterly passengers creates a bias as most of the airports in the sample are larger airports which are often dominated by larger FSCs who use these airports as hubs. Previous literature has found that routes which are operated through hubs tend to have higher airfares due to market dominance (Goetz, 1992). Therefore, the use of average airfare prices on these routes may not accurately reflect market conditions and pricing strategies. Future research should incorporate the exact pricing set by new entrants upon entry and investigate how incumbent LCCs and FSCs respond to these pricing strategies, giving a more precise view of pricing dynamics.

Finally, this paper focused on the positive aspects of low-cost carriers such as the consumer benefits due to reduced airfares. However, future research should investigate the negative implications of LCC entry and expansion. The entrance of an LCC into a market generally leads to increased passenger numbers and flight volumes due to lower airfares (Windle and Dresner, 1995). Increased air traffic can also lead to heightened greenhouse gas emissions which can cause significant damage to the environment. While these changes benefit consumers through lower airfares, they pose serious environmental risks as LCCs continue to operate older, less fuel-efficient aircrafts. Therefore, it is crucial for future research to incorporate the environmental effects of LCC expansion and focus on the broader ecological impacts, rather than consumer welfare.

8. Conclusion

To conclude, this research delves into the pricing dynamics of the airline industry by investigating the heterogeneous effects of LCC and FSC entry. Using quarterly data from the first quarter of 2015 until the fourth quarter of 2019 derived from the US Bureau of Transportation Statistics, this research builds upon previous papers by using more recent data and airlines. Furthermore, the investigation on the existence of a size effect among LCCs is a relatively understudied area of the industry, which is explored in this thesis.

Inspired by the works of Goolsbee and Syverson (2008) and Windle and Dresner (1995), the first part of this paper investigated the heterogeneous effects of LCC and FSC entry over time. The results find that the entrance of a low-cost carrier is associated with a 9%-11% reduction of airfares in the short run, before stabilizing at 8% below pre-entry level airfares in the long-run. In contrast, the entrance of a full-service carrier is associated with a 3% increase of average airfares which remains constant throughout the studied period. This indicates that the entrance of an LCC exerts more downward pressure on airfares in all periods following entry when compared to FSCs.

The regression results of the second model provide some evidence to support the existence of a size effect among the studied LCCs, with Southwest having nearly double the effect on the reduction of airfares compared to smaller LCCs. However, additional analyses have shown that the existence of a size effect cannot be fully determined among the other LCCs, indicating the need for further research.

Even though this research provides significant insights into the pricing dynamics of the airline industry, it is important to note the main limitations of this paper as well. This paper concluded that the entrance of LCCs significantly reduces airfares in all periods following entry in the domestic US market, with this reduction being more profound upon the entry of Southwest compared to smaller LCCs. Therefore, policymakers may find it beneficial put in place legislations that promote competition and encourage the expansions of LCCs in the domestic US market.

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Data sources:

Route level data: https://www.transtats.bts.gov/Fields.asp?gnoyr_VQ=GEE

Airfare prices and market share of largest carrier: https://www.transportation.gov/office-policy/aviation-policy/domestic-airline-consumer-airfare-report-pdf

Market share of airlines used in this paper: https://www.transtats.bts.gov/

State income per capita: https://www.bea.gov/data/income-saving/personal-income-by-state

Appendices

Appendix A

Table 8: Individual t-tests to confirm the significance of LCC entry variables.

Variables	t	p-value
LCCentry	-6.811	< 0.001
LCCentry2q	-6.473	< 0.001
LCCentry3q	-5.759	< 0.001
LCCentry4q	-5.541	< 0.001
LCClong	-6.016	< 0.001

Note: * for p ≤ 0.10,** for p ≤ 0.05, and *** for p ≤ 0.01, significance levels

Table 9: Individual t-tests to test the difference of coefficients between LCC and FSC entry over time.

Variables	Coefficient	t	Std error
LCCentry - FSCentry	-0.125***	-9.63	0.013
LCCentry2q - FSCentry2q	-0.130***	-7.41	0.018
LCCentry3q - FSCenrty3q	-0.117***	-6.64	0.018
LCCentry4q - FSCentry4q	-0.121***	-6.83	0.018
LCClong - FSClong	-0.116***	-10.31	0.011

Note: * for p ≤ 0.10,** for p ≤ 0.05, and *** for p ≤ 0.01, significance levels

Appendix B

Table 10: Individual t-tests depicting the difference between larger and smaller LCCs across all periods.

Variables	**Coefficient**	**t**	**Std error**
SouthwestEntry – JetBlueEntry	-0.149***	-4.10	0.036
SouthwestEntry_2q – JetBlueEntry_2q	-0.111**	-2.26	0.049
SouthwestEntry_3q – JetBlueEntry_3q	-0.090*	-1.84	0.049
SouthwestEntry_4q – JetBlueEntry_4q	-0.121**	-2.45	0.049
SouthwestEntry_long – JetBlueEntry_long	-0.116***	-4.41	0.026
SouthwestEntry – FrontierEntry	-0.177***	-7.89	0.022
SouthwestEntry_2q – FrontierEntry_2q	-0.188***	-6.24	0.030
SouthwestEntry_3q – FrontierEntry_3q	-0.181***	-6.02	0.030
SouthwestEntry_4q – FrontierEntry_4q	-0.173***	-5.61	0.031
SouthwestEntry_long – FrontierEntry_long	-0.141***	-7.97	0.018
JetBlueEntry – FrontierEntry	-0.028	-0.79	0.035
JetBlueEntry_2q – FrontierEntry_2q	-0.077	-1.63	0.047
JetBlueEntry_3q – FrontierEntry_3q	-0.091*	-1.93	0.047
JetBlueEntry_4q – FrontierEntry_4q	-0.053	-1.10	0.048
JetBlueEntry_long – FrontierEntry_long	-0.025	-0.98	0.026

Note: * for p ≤ 0.10,** for p ≤ 0.05, and *** for p ≤ 0.01, significance levels