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THE LINKAGES AMONG MARKET STRUCTURE, MARKET CONDUCT, AND SERVICE QUALITY: ANALYSIS OF THE U.S. DOMESTIC AIRLINE INDUSTRY

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A Dissertation Presented

by

AMIRHOSSEIN ALAMDAR YAZDI

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DEDICATION

To my family

ACKNOWLEDGMENTS

I would like to thank my advisor, Dr. Adams B. Steven, for his thoughtful and continued support throughout my graduate studies. His friendship and selfless contribution to my professional development have been invaluable and will be appreciated forever.

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ABSTRACT

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SEPTEMBER 2018

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As supported by the dynamic structure-conduct-performance (S-C-P) paradigm, market structure affects conduct, and conduct determines firms' performance (Mckinsey & Company Quarterly, 2008). Several researchers have looked at the S-C-P relationship with focus on price. Boreinstein, 1990; Beutel and McBride, 1992; Kim and Singal, 1993; Morrison, 1996; Veldhuis, 2005; Peters, 2006; Zhang and Round, 2009 looked at the effect of airline mergers on fares; some others have looked at the linkage between the imposition of fees and stock values (Barone, et al., 2012), ticket prices (Henrickson & Scott, 2012; Brueckner, et al., 2015); and some examine the effects of low-cost carriers entry/threat of entry on incumbent fares (Goolsbee & Syverson, 2008; Dennis, 2007).

Even though there have been many studies on the impact of mergers/introduction of ancillary fees/low-cost threat on airfares, the linkage to service quality has received very little

attention. This study investigates the linkages among market structure, market conduct and service quality in the US domestic airline industry. In this dissertation, provided in three essays, I specifically answer the following three questions. 1- How do mergers and acquisitions affect service quality? 2- How does the introduction of baggage fees affect service quality? 3- How does a threat of entry or an entry of a low-cost carrier affect incumbent service quality and airfare?

The first essay studies the relationship between mergers in the US domestic market and service quality, as measured through late flights, mishandled bags, involuntary boarding denials and flight cancellations. The results show that in the immediate years following a merger, service quality generally deteriorates, and that the drop in service is due simultaneously to the merger and the increased concentration of the market. Thus, recent mergers in the US, including Delta and Northwest, United and Continental, Southwest and AirTran, have likely resulted in increased market concentration and decreased service levels. From a public policy perspective, the results point to the importance of regulators monitoring airline actions, such as mergers and acquisitions, that serve to increase the concentration of markets, and may also result in decreased service quality.

The second essay examines the linkages between the implementation of baggage fees and late flights in the airline industry directly, and indirectly through passenger demand and adjustment in ticket price. Findings show that baggage fees policies result in improvements in on-time performance as assessed through late flights, directly through improvements in airport-side sorting and loading efficiencies, and indirectly through lower air travel demand. It is further shown that these relationships are contingent upon the presence of a hub airport on a route. The results have important managerial and public policy implications as baggage fees have often been cited as a driver of security queue, aircraft alley, and overhead bin congestions, and ultimately delayed flights. The findings suggest that these suppositions could be misplaced.

The third essay conducts a simultaneous analysis of the effects of threat of entry and entry of Southwest on incumbent carriers' on-time performance as well as yield, in the US Airline Industry. The results show that, on average, incumbent carriers' yield and on-time performance decrease in both threat and entry periods; and that the drops in on-time performance and yield are partially linked to each other indirect effect. It is further shown that the effects of entry or threat of entry of Southwest on incumbent carriers depend highly on the general, long run pricing policy and on-time performance of those carriers. Further analysis shows that market concentration plays an exacerbating role; on the concentrated routes, the impacts of threat of entry and entry on on-time performance and yield are more severe. The findings of this study have important managerial and public policy implications as it provides a thorough assessment on incumbent carriers’ reactions to threat of entry and entry.

The dissertation is based on the following papers: Steven et al, 2016, and Yazdi et al, 2017, and a working paper coauthored by Yazdi and Steven.

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CHAPTER 1

INTRODUCTION AND RESEARCH MOTIVATION

A firm’s (as a part of an industry) performance is the outcome of industry structure and conduct. As supported by the timeless structure-conduct-performance (S-C-P) paradigm provided by Mckinsey & Company (Mckinsey & Company Quarterly (2008)), firms react to changes in the structure of an industry (e.g. concentration caused by consolidation) or shocks from outside of the industry (e.g. economic recession, increases in fuel price), and these reactions consequently affects performance.

One way to assess performance of a firm is via quality of the services it provides to its customers. Quality is a metric that is critical and paramount for a firm to be competitive in the market. In a short-term horizon, firms with high-quality services suffer less from the unforeseeable costs of service failures, which can be leveraged by the firm to control its prices, attract more customers, and increase its overall profitability. In the long run, due to positive correlation between a firm's quality and customer satisfaction, firms with high-quality services not only afford to maintain loyal customers that secure them steady revenue in the future, but also benefit from the firm's strong reputation that enables them to capitalize on their brand value (Linton, 2017).

Several works have looked at the linkage between actions/reactions and performance primarily assessed through financial outcomes (e.g. Barone, et al., 2012; Ramaswamy & Waegelein, 2003; Lubatkin, 1983). The literature, however, does not adequately address the linkage to service quality in the context of service industry.

Given the importance of service quality, it is surprising why there is a dearth of literature on the linkages between firm actions and quality outcomes. Only a few papers have looked at quality in the context of service industry. Among the studies done on the firm action-service quality linkage, Vogt and Town, (2006) identified 10 studies which investigated the effect of hospital consolidation on the quality of care in the healthcare industry; Nicolae, et al., (2016) looked at the effects of baggage fees implementation on departure delay in airline industry; and Scotti, et al., (2016) studied the relationship between fees and customer satisfaction. In all these studies, however, the linkages between firm non-quality related actions such as mergers, or the introduction of ancillary fees are not either significantly addressed, or the findings are mixed.

In this dissertation, I concentrate on the non-quality actions-quality linkage in the service industry. Using arguments proposed by the dynamic S-C-P paradigm, I look at some of the actions of individual firms that have affected either market structure or conduct and consequently firm performance (quality). Specifically, I investigate the following research questions:

- How do actions such as mergers, acquisitions, and alliances (conduct) in reaction to external shocks such as economic recession, rising fuel costs and political uncertainty affect structure of the market?
- How does market concentration (changes in structure), created by actions such as mergers, acquisitions, and alliances (conduct) affect service quality (performance)?
- How does the introduction of ancillary fees such as baggage fees (conduct) affect product pricing (conduct)?
- How does the introduction of ancillary fees such as baggage fees (conduct) affect customer behavior (conduct)?
- How do changes in customer behavior caused by implementation of ancillary fees (conduct) affect service quality (performance)?
- What strategies do incumbent firms adopt in response to a threat of entry/entry of a low-cost competitor (structure)?
- How does following these strategies consequently affect service quality (performance)?
- How does following these strategies consequently affect market fare (performance)?

The importance of this study is three-fold:

1- First, this study contributes significantly to fill in the academic gap that exists in the literature on the linkages between firms’ actions/reactions and quality in a service industry. This study investigates several research questions and makes important conclusions. Furthermore, as a result of this study, several academic questions are raised for future research.

2- Second, from the industry point of view, this study has valuable managerial implications. Quality is known as one of the drivers of cost and profitability that need to be given sufficient attention by the firm’s management team.

3- Third, this study is also important for public policy makers and regulators. Firms’ actions/reactions (such as consolidation and mergers) may affect structure of the market (concentration) and consequently market outcomes such as quality and price. Public policy makers therefore need to consider the impact of such actions/reactions in shaping policies that govern the market place.

Presented in three essays, my dissertation setting is the airline industry. The aviation industry is the perfect candidate for this investigation for many reasons.

First, historically, it has been the most regulated industry. Since 1938, the U.S. government had regulated all domestic interstate air transport routes as a public utility. Airline prices, routes and schedules were all controlled by the Civil Aeronautics Board (CAB), with the goal of serving the public interest. Almost any attempt to provide a lower price by an airline was unsuccessful; and airlines competed only on services. The legacy of such control over an industry is a well-defined market, and a pseudo perfectly competitive market post deregulation. Consequently, it is structurally the most defined industry in terms of markets and products. Second, it is one of the biggest and well-studied service industries. Findings on such an industry is easily generalizable to other industries. Third, the industry provides the most comprehensive and accurate data on their products, prices, and market structure.

In the first essay, I study the relationship between the recent mergers and acquisitions, and the consequent consolidation of the airline market and service quality. The intense competition among airlines post deregulation, which heightened in the 1990s suppressed profitability. The average carrier was operating at a loss[1]. Carriers therefore chose to consolidate their operations by laterally merging or acquiring their competition. While the literature is quite established on the resulting effect on air fares, how such mergers affect service quality is unknown a priori. I therefore examine the relationship between mergers in the US domestic market and service quality, as measured through late flights, mishandled bags, involuntary boarding denials and flight cancellations. I examine three US domestic mergers that have occurred since 2004 and estimate the

[1] Only southwest was profitable for most of the early 2000s.

relationship between these four service variables and mergers at both route and carrier levels.

Mergers I argue, affect service quality in different ways. Directly, mergers may improve quality through the efficient use of resources but may also lead to lower quality through the exercise of market power and consolidation challenges. Indirectly, through market concentration, mergers may result in lower quality, not just for the merged carrier, but also for other carriers operating on affected routes due to the reduced competition. The final effects of mergers on service quality may be difficult to predict *a priori*.

For all service variables, the results indicate that mergers have contributed to service deterioration in the immediate years following the mergers. The direct effects of mergers on percent of late flights, flight cancellations, mishandled bags, and involuntary boarding denials are unequivocally undesirable. Further, the resulting increased market concentration from mergers also has an undesirable impact on all four service measures. My statistical analyses also show that the impact of mergers on these service measures fades away for all service measures starting in the sixth quarter following the merger.

In the second essay, I investigate the effects of the imposition of baggage fees (BF, hereafter) on airline service quality as assessed through late-flights, mishandled bags, and complaints. The unbundling of BF from the base fare, since its inception by the low-cost carrier, Spirit Airlines, in 2007, has become a popular strategy in the industry. The annual revenue from fees has increased substantially from 464 million USD in 2007, to 3.8 billion USD in 2015 (Bureau of Transportation Statistics), accounting for about 2.1 percent of total operating revenue across the industry. At present Southwest is the only carrier that does not charge any fees for first and second checked-in baggage.

The implementation of ancillary fees such as baggage fees in the airline industry affects service quality in different ways. Indirectly through changes in passenger demand, BF implementation would lead to an improvement in delivery quality. Directly, it could improve through improvements in airport-side operations or worsen through congestion of security queues and overcrowding of aircraft overhead bins and walkways. The final effect is hard to predict and left to conjecture by managers and policy makers. In this essay, I examine the effect of implementing BF by US carriers utilizing a flight level aggregated to route level comprehensive data. I examine eleven carriers, ten of which had implemented baggage fees.

The statistical results indicate that on average, fees implementation result in improved service quality as assessed through late flights, mishandled bags, and complaints directly, as well as indirectly via ticket prices and market demand. The results also indicate that the improvements are influenced by the presence of hub-airports on the route, and the classification of travelers as leisure or business.

In the third essay, I investigate the effects of threat of entry (hereafter TOE), and of entry (hereafter ET) of a new carrier into a route market, on the behaviors of incumbent carriers (hereafter ICs). Specifically, I look at TOE and ET as driving factors of changes in the ICs' service quality and pricing behavior. Theoretically and even empirically, the total effect of TOE and ET on ICs is ambiguous, and the conclusions drawn in the literature are mixed.

In terms of air fare, some researchers have concluded that TOE and ET have downward pressure on airfares of incumbent carriers (e.g. Daraban and Fournier, 2008; Goolsbee and Syverson, 2008). Some other researchers (e.g. Tan, 2011; Gayle and Wu, 2013; Aydemir, 2012), however, have made a different conclusion that the effect of TOE or ET on an IC is not always downward pressure; instead, the effect may vary from one case to another.

There is no consensus on the effect of TOE and ET on air service quality either. On one hand, both TOE and ET increases the potential of competition. Consequently, to stave off the competition, ICs may improve their service quality. Higher service quality though results in higher costs (Prince and Simon, 2014). Given that carriers also compete on airfares, this may result in changing the fare to accommodate the changes in quality. If carriers determine that the effects of price competition trump that of service quality competition, they may lower service quality to be able to compete on the price front. TOE and ET therefore, may result in lower service quality.

The 3SLS regression results show that incumbent carriers, in response to entry of Southwest, decrease their yield to compete on price line. Also, the on-time performance of incumbent carriers generally deteriorates, and that the drop in on-time performance is partially linked to the adopted pricing policy. It is further shown that the effects of entry or threat of entry of Southwest on incumbent carriers depend highly on the general, long run pricing policy and on-time performance of incumbent carriers. Moreover, my statistical analyses also show that the effects of threat/entry of Southwest depends highly on the market competition. In a very competitive market, incumbent carriers surprisingly increase their yield in reaction to SW TOE.

The rest of this chapter is as follows: In Section 1.1 I provide some details on the background of S-C-P paradigm. Section 1.2 provide a short history of the airline industry with concentration on incidents that have happened since 1978 deregulation. Section 1.3 describes the database sources used in this study; and Section 1.4 provides an overview of the dissertation following with the contribution of my essays.

1.1 Theoretical Background (SCP)

Structure-Conduct-Performance in a very basic format explains the interrelationship between an industry structure, a firm conduct within that industry, and the firm's performance. The performance of an industry, that is, the benefits of consumers and society, depends on the conduct of the industry, that is, the behavior of firms within the boundaries of the industry, which in turn depends on the structure of the market. In other words, the structure has a big influence on conduct, and conduct basically determines the performance.

1.1.1 Mason, 1930s

In the 1930s, while working on case studies, Mason, a Harvard economist, adopted an analytical framework known as Structure-Conduct-Performance (S-C-P) to stipulate the causal relationship between market structure, conduct and performance. He used this paradigm to explain how imperfect competitive markets work with the focus on market structure. Even though Mason is the first one who developed the S-C-P framework, it is mostly known by Joe Bain's work.

1.1.2 Joe Bain, 1950s

Joe Bain (Mason's doctoral student) was one of the members of Mason's group who worked on the S-C-P approach with a focus on the barriers to entry. Bain's findings show that there is a positive correlation between profits and entry barriers. His results further explain that when incumbents make profit above normal, a market is not attractive for potential competitors to enter because of the presence of barriers to entry. His findings (in 1956) identified scale economics, absolute-cost advantage, and product differentiation as three sources of entry barriers. He believes that in the case that a monopolistic power depends on market structure, and the market is concentrated due to entry barriers, competition policies are needed. His view of S-C-P paradigm is broadly used to make antitrust de-concentration policies.

1.1.3 Michael Porter, 1980s

In 1980, Michael Eugene Porter, an American economist, used the S-C-P paradigm, to the advantage of business people, to develop his Five Porter Forces models. His view, in the first instance, is completely the opposite of the antitrust approach. He uses the S-C-P paradigm to figure out how businesses actually can make more money, while public policy makers use the S-C-P paradigm and the arguments supported by S-C-P to stop companies from making too much profit.

1.1.4 Mckinsey & Company, 1980s

In 1980s Mckinsey introduced an extended version of S-C-P paradigm (Figure 1) by adding a dynamic element to the static framework. The dynamic model suggests that the relationships among three elements, Structure, Conduct and Performance is not unidirectional and can be in any direction.

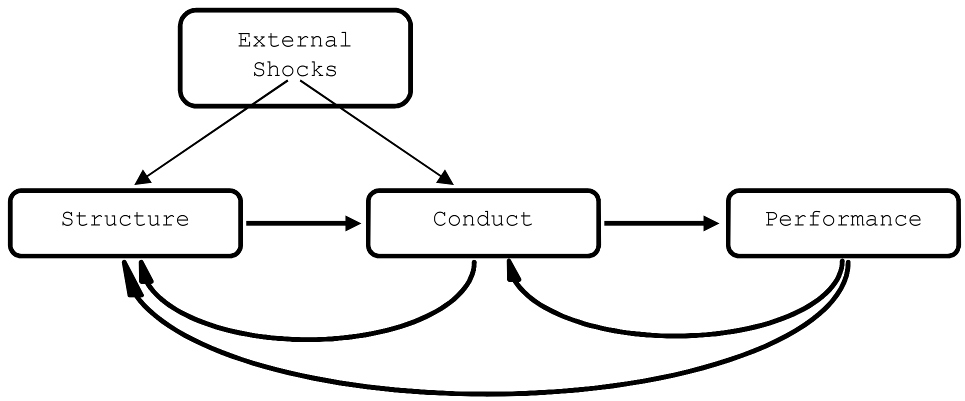

Figure 1- Dynamic Structure Conduct Performance Paradigm

1.1.5 Market Structure

The Market Structure explains the environment in which firms in a market operate. It basically refers to a set of variables that are relatively stable over time and affect how the players of an industry, buyers and/or sellers, interact with each other. Following are the major elements of market structure mentioned in the literature that make the market avoid from perfect competition condition:

- The number of buyers and sellers (demand/supply concentration)
- Product differentiation
- Barriers to entry
- Vertical and horizontal integration.

1.1.6 Market Conduct

The Market Conduct refers to the behaviors of buyers and sellers both amongst each other, and amongst themselves in a particular market, in terms of decisions they make, in response to the market conditions formed by the structure of the market. Following are the major elements of conduct:

- Pricing behavior
- Advertising research and development
- Plant investment
- Legal tactics
- Product choice
- Collusion
- Mergers and contracts.

1.1.7 Market Performance

Market Performance refers to the performance of firms in an industry. Based on this model, a firm performance is the outcome of market structure and conduct. The market performance is measured by comparing the results of firms in the industry. Different measures are used to determine how a firm/market performs. Following are some of them:

- Productive efficiency
- Allocative efficiency
- Product quality
- Technical progress
- Profits.

1.2 Airline Industry Trends in the United States

1.2.1 Pre-Deregulation 1938-1978

Starting in 1938 with the establishment of the Civil Aeronautics Board (CAB), government regulated all domestic interstate air transport routes as a public utility. Airline prices, routes and schedules were all controlled by CAB, with the goal of serving the public interest. Almost any attempt to provide a lower price by an airline was unsuccessful and airlines competed only on services.

1.2.2 Post-Deregulation

In 1978, the President, Jimmy Carter, signed into law the Airline Deregulation Act to meet two critical objectives: to help fight against inflation and to ensure American citizens of an opportunity for low-priced air transportation. This act changed the structure of the airline industry from a completely regulated market to a free market[2].

With deregulation, government control over price, route schedules and airline entry were lifted resulting in formation of a competitive market. Since then, airlines can set their own price and operate on a route as long as they operate in accordance with safety standards. Deregulation, also, allows airlines to create new business models and enter the airline market.

1.2.3 Consolidation and Mergers

The airline industry has never been stable since the 1978 deregulation. Right after deregulation, in the 1980s, the airline

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[2] The airline industry after deregulation is still partially regulated, since local governments have control over airports in terms of access to boarding gates and runways. (Gowrisankaran 2002)

industry experienced one of the most turbulent periods in US aviation history. The early 1980s recession[3] along with the severe competition caused many airlines that were formed out of deregulation to go bankrupt or to merge. In 1990s, the economy underwent the same experience. Increased fuel costs and political uncertainty from the first Gulf War[4] further destabilized the industry.

All these factors (severe competition, economic recession, increased fuel costs and political uncertainty) caused airlines to stop operating or to go under bankruptcy protection. Since 1990 more than 189 airlines declared bankruptcy, and many airlines, to survive, merged. Recent mergers have concentrated the industry into only four major operators. Delta and Northwest filed bankruptcy and merged in 2005; United and Continental merged in 2010, and Southwest and AirTran merged in 2011. Figure 2 demonstrates the mergers that have happened in the US Airline industry since deregulation.

1.2.4 Low-cost carriers

One of the consequences of deregulation is the emergence of low-cost carriers. Before deregulation, the US government had control over prices, and airlines could not set the price themselves. However, after deregulation government control over

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[3] The early 1980s recession in the United States began in July 1981 and ended in November 1982.

[4] 2 August 1990 – 28 February 1991

prices was lifted which led airlines with low-cost strategies to expand and become powerful. For example, Southwest, which is now known as the most successful low-cost carrier, in 1978 (market was still regulated) was able to fly only intra-Texas routes, where the Civil Aeronautics Board (CAB) did not have authority. However, Southwest, in 2016, was the leading airline in the U.S. with a domestic market share of 20.65% (Statistics Portal, 2016).

What enables a low-cost carrier to be competitive to a legacy carrier is its business model. The low-cost business model[5] aims to simultaneously reduce the costs and to maximize the productivity (Vasigh et al, 2013). To achieve this goal, they adopt their own unique strategies, some of which are briefly described in the following:

1- In order to reduce the service costs, the low-cost carriers follow no-frills strategies, in which unnecessary and luxurious services are avoided. This is how customers used to distinguish a low-cost carrier from a legacy carrier. However, today, legacy carriers have also switched to no-frills services to be competitive with low-cost carriers.
2- A majority of ticket sale services are conducted online. This is a common strategy among low-cost carriers to reduce both the ticket distribution costs (cut agent commission)

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[5] Southwest, established by Herb Kellher and Rollin King in 1967, is the first example of an Airline with the low-cost business model.

and labor. For example, Southwest's website accounted for almost 78% of all Southwest bookings in 2011.

3- An interesting strategy of low-cost carriers is to use a common fleet type. This strategy is paramount in reducing the inventory costs, reducing cost of training the flight crew, giving bargaining power for bulk purchases and economies of scale.

4- Unlike legacy carriers that have a hub-and-spoke network structure, low-cost carriers operate a point-to-point or origin-destination route structure. One of the advantages of this strategy is that there is no peak level of flight, and this enables low-cost carriers to operate more flights with fewer facilities and personnel and consequently lower costs.

5- Low-cost carriers mainly use the secondary airports. The reason is two-fold: primary airports are more expensive and less time-efficient due to high flight congestion, and secondly, to attract airlines, secondary airports offer low-cost carriers some discounts. All these lead to lower cost for airlines and obviously lower airfare.

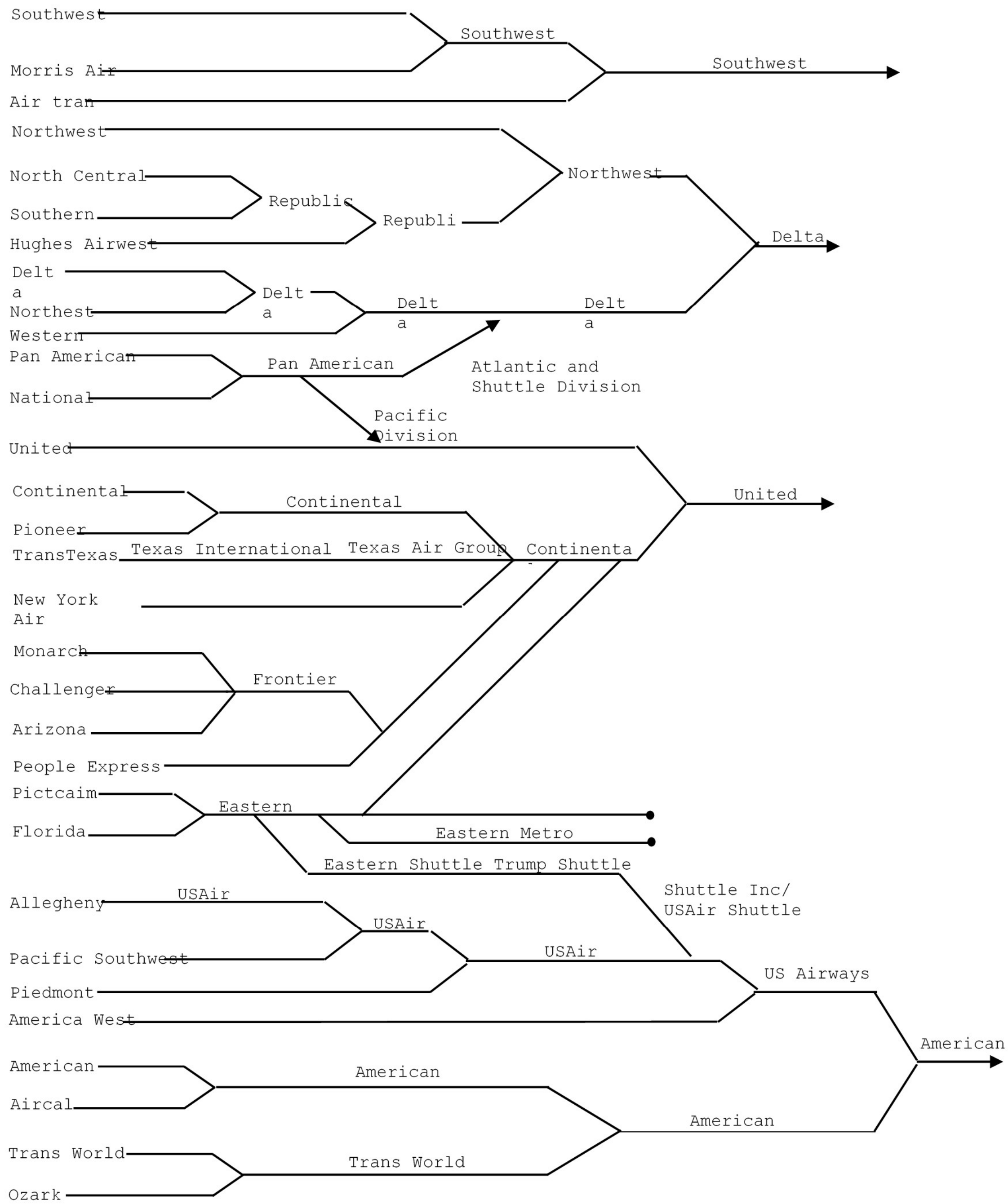

Figure 2- US mergers after deregulation (taken from Vasigh et al, 2013 and modified)

1.3 Databases

The dissertation is comprised of three essays, and for each essay I constructed a unique dataset. The data come from different sources. In this section, I detail these sources.

1.3.1 On-time Performance Database[6]

The on-time database provided by United States Department of Transportation, Bureau of Transportation Statistics includes information such as departure and arrival actual time, departure and arrival scheduled time, departure and arrival delay, origin and destination airports, distance, number of flights, cancelled or diverted flights, taxi-out and taxi-in times, and air time for non-stop domestic flights. Certified U.S air carriers that account for at least one percent of domestic scheduled passenger revenue are required to report the above information. Data has been reported since 1987; and the unit of data is at flight level.

1.3.2 DB1B Market[7] (Origin and Destination Survey)

The DB1B Market Database is also provided by the United States Department of Transportation, Bureau of Transportation Statistics. This database reports information such as the number of passengers, ticket price, origin and destination airports, whether the market is domestic or international, operating and

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[6] https://www.transtats.bts.gov/Fields.asp?Table_ID=236
[7] https://www.transtats.bts.gov/DL_SelectFields.asp?Table_ID=247

ticketing carrier, and distance. The information has been reported quarterly since 1993. The number of total available records is 461,244,990 (almost 19,200,000/year), which is just a 10% sample of airline tickets from reporting carriers.

1.3.3 T100 Domestic Segment[8] (Air Carrier Financial)

T100 Domestic Segment Database is provided by the United States Department of Transportation, Bureau of Transportation Statistics. It includes information such as carrier, origin and destination airports, aircraft type and service class for transported passengers, freight and mail, available capacity, scheduled departures, departures performed, aircraft hours, load factor and distance. This database has been reported by both U.S. and foreign air carriers which operate on routes within the boundaries of United States and its territories since 1990.

1.3.4 Air Travel Consumer reports

The Department of Transportation's Office of Aviation Enforcement and Proceedings (OAEP) provides monthly reports about Flight Delays, Mishandled Baggage, Oversales, Consumer Complaints, Customer Service Reports to the Transportation Security Administration, and Airline Reports of the Loss, Injury, or Death of Animals During Air Transportation to help customers with information on service quality provided by airlines. The

[8] https://www.transtats.bts.gov/DL_SelectFields.asp?Table_ID=311

above information has been reported since 1998 and they are at carrier level.

1.4 Dissertation Overview

The dissertation consists of five chapters. Chapter 1 includes the research motivation, a brief history of the airline industry and some information about databases used in this study. Chapter 2 is dedicated to Essay 1 in which I study the relationship between mergers and service quality. Chapter 3 provides Essay 2 which is about the linkage between baggage fees and on-time performance. Chapter 4 presents Essay 3 in which I will examine the linkage between the Southwest entry/threat of entry, service quality and market fare. Chapter 5 concludes the dissertation by summarizing my findings from this study. Below I detail the contributions of my three essays in Chapters 2, 3, and 4.

1.4.1 Essay 1 Contribution

This Chapter makes at least three significant contributions:

First, from a public policy perspective, the study points to the importance of regulators monitoring airline actions, such as mergers and acquisitions, which may lead to decreased service quality. It may not be sufficient for regulators to monitor the impact of these mergers on fares, alone, since service levels can also be impacted.

Second, the modeling approach allows us to isolate the indirect effect of mergers on service quality through market concentration from the direct merger-service quality relationship. Since mergers vary in the degree of market concentration that results, the approach allows policy makers to make better predictions as to the impact of the mergers on service quality. Mergers that result in significantly higher market concentration may contribute to substantially greater service deterioration compared to mergers where the market overlap is not particularly high.

Third, from a managerial perspective, the study demonstrates how mergers may contribute to the decline in service quality among affected carriers. This service level decline leaves open potential advantages to competitors to gain customers by providing superior service alternatives to the merged carrier.

1.4.2 Essay 2 Contribution

This Chapter makes at least four significant contributions:

First, to the best of my knowledge this is the first research that investigates the effect of BF on airfare, passenger demand, and on-time performance of carriers simultaneously. This is a significant contribution as investigating these relationships independently overlooks the interdependencies among these three factors and consequently, the overall effect of BF policies. Also ignoring these simultaneous relationships may not only result in biased findings, but also fail to highlight the nuanced effects of BF that can provide managerially useful insights.

Second, the modeling approach allows us to isolate the indirect effect of BF on late flights through adjustments in air ticket prices, and demand for air travel, from the direct BF–late flight relationship. The approach does not only allow policymakers to make better predictions as to the impact of the fees on on-time performance, but it also allows managers to see the unintended consequences of such ancillary fees on the bottom line through its impacts on airfare, demand, and late flights.

Third, in trying to understand the relationship between BF and on-time performance, I identify moderators which can further provide managerial insights.

Fourth, the magnitude of the dataset (a panel data spanning over 12 years from 2003-2014, on 12 airlines), and the level of analyses (disaggregated at route level), would add value in truly understanding how on-time performance of carriers has changed over time with respect to imposition of BF.

1.4.3 Essay 3 contribution

This chapter makes some significant contributions:

First, to the best of my knowledge, this is the first paper to consider the effect on prices as well as quality of ICs simultaneously, of TOE and ET of new carriers. This is managerially a significant contribution as it gives a holistic assessment on ICs behavior of TOEs and ETs.

Second, the proposed research model not only allows policy makers to better understand the relationship between TOE/ET and ICs behavior, it also allows managers to observe the unintended consequences of adopting such policies on on-time performance and airfare.

Third, prior empirical works on the relationship between TOE/ET and service quality have found mixed results. By categorizing the incumbent carriers based on their long run service performance and market fare, this study helps to explain these contradictory results better.

Fourth, toward better understanding of the effects of TOE/ET on ICs' behavior, a moderator is introduced which can provide further insights.

CHAPTER 2

MERGERS AND SERVICE QUALITY

The US domestic airline industry has seen considerable consolidation since 2005, beginning with the US Airways and America West merger. Since then, there have been four additional large-scale mergers in the industry: Delta and Northwest in 2009, United and Continental in 2010, Southwest and AirTran in 2011, and most recently, American Airlines and US Airways in 2013. Considerable attention (for example, Boreinstein, 1990; Beutel and McBride, 1992; Kim and Singal, 1993; Morrison, 1996; Veldhuis, 2005; Peters, 2006; Zhang and Round, 2009) has been given to the effect of airline mergers on fares, both by researchers and policy makers. Most of the studies find that mergers result in higher prices for air travelers, although a minority of these studies find negative to no significant effects (Zhang and Round, 2009).

Even though there have been many studies on the impact of mergers on airfares, the effect of mergers on service quality has received very little attention. In this Chapter, I examine the effect of mergers on four different measures related to air service provision: late flights, mishandled bags, involuntary boarding denials and flight cancellations. *A priori*, it is not clear what impact mergers may have on service quality. Reduced competition and higher market concentration levels following a merger could lead to complacency among carriers, thus having a negative effect on service quality. A merger may also result in lower service levels, at least during the transition phase after the merger, due to difficulties in consolidating operations between airlines. This phenomenon was widely documented in the popular media following the Continental-United merger, with reported consolidation difficulties persisting for a considerable period after the merger.

However, at some point following the merger, service may improve and may even get better than the original level. The consolidation of assets, including labor, following a merger, leading to a larger pool of available assets to conduct operations, could provide flexibility which, in turn, may improve service provision. For instance, additional baggage handlers or check-in posts on overlapping routes or at overlapping airports could improve baggage handling as well as on-time flight arrivals. Given the potential implications of mergers to the provision of service in the airline industry, it is surprising, therefore, that very little research has been conducted on the merger-service quality relationship in the airline industry.

The rest of the Chapter is organized as follows: Section 3.1 discusses the literature on mergers in the airline industry as well as in other industries. The literature review is followed by a hypotheses section (3.3). Section 3.3 discusses the research methodologies and the data used for the analysis, while Section

3.4 presents the findings. In the last section (3.5), conclusions are presented, along with research and managerial implications.

2.1 Literature Review

Several researchers have investigated airline mergers, alliances and codeshare agreements and their effects on airline fares and consumer welfare. Two consequences are generally proposed for the effects of mergers on airfares: First, it has been argued that mergers and other forms of consolidation lead to higher fares due to industry concentration (for example, Borenstein, 1990; Morrison, 1996; Peters, 2006). On the other hand, the efficiency argument posits that the consolidation that follows a merger may help the merged firm exploit economies of scale and scope and synergies in order to achieve efficiencies and cost savings. Some of these savings may be passed through to passengers through lower fares. For example, Zhang and Round (2009) found lower fares following the mergers of three Chinese carriers. As such, the impact of mergers on fares work in opposite directions – reduced competition may lead to higher fares while decreased costs following consolidation may result in lower fares. The final outcome of a merger, therefore, depends on which of these two effects is the strongest. Table 1 provides a snapshot of the literature linking mergers and fares in the airline industry.

Table 1 - Summary literature on merger-price/frequency relationship

Name	Airlines	Finding
Boreinstein (1990)	Northwest-Republic Airline, Transworld-Ozark airlines	positive effect on price, negative effect on frequency
Beutel and Mcbride (1992)	Northwest-Republic Airline	Positive effect on yield or price
Kim and Singal(1993)	Several mergers between 1983 and 1987	Positive effect on price
Morrison (1996)	Northwest-Republic Airline, Transworld-Ozark airlines, USAir-Piedmont	Positive effect on price
Veldhuis (2005)	Air France-KLM	positive effect on price
Peters (2006)	5 different mergers that occurred 1986 and 1987	Positive effect on price
Dobson and Piga (2009)	EasyJet-Gofly; Ryanair-Buzz	Negative effect on price
Zhang and Round (2009)	Two different mergers involiving multiple carriers in China	Negative effect on price
Kwoka and Shumilkina (2010)	USAir-Piedmont	Positive effect on prices on both affected routes and potential routes
Merkert and Morrell(2012)	Several mergers	Inverted U-shape relationship
Fageda and Perdiguero (2014)	Iberia-Clickair-Vueling	positive effect on price, negative effect on frequency

While the focus of research in the airline industry has been on the impact of mergers on fares and to a lesser extent on flight frequencies, mergers may also affect an airline’s service quality. However, this impact has not been examined. The paucity of work on the merger-service quality nexus in the airline industry, coupled with the importance of airline service to the traveling public, contributes to the need to conduct additional research in this area.

2.2 Conceptual Background and Research Questions

Conceptually, I propose an indirect merger-service quality relationship via market concentration, and a direct relationship through efficiency and market power. Figure 3 presents the theoretical framework of these relationships.

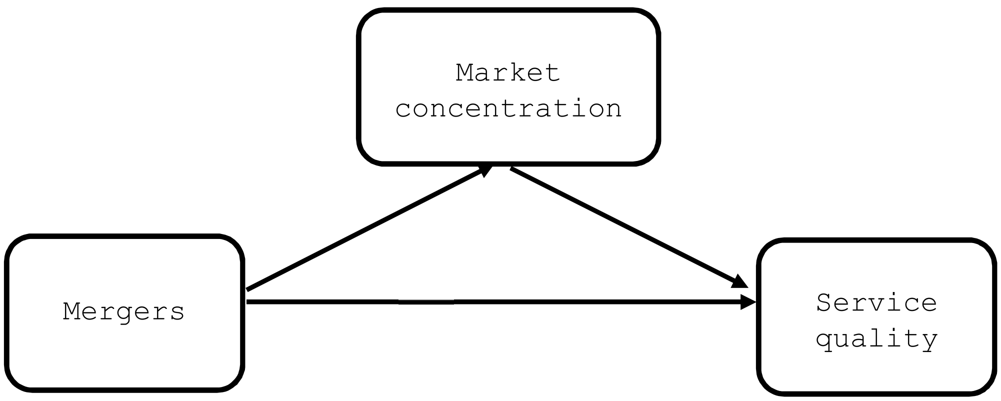

Figure 3 - Merger-Service Quality linkage, Research Model

Mergers and acquisitions may affect service quality directly, through efficiency and/or through market power. Mergers can lead to improvements in service quality through two mechanisms that positively affect the efficient use of resources. First, merging firms combine assets which may provide operational flexibility and hence improved service quality; for example, a larger number of gate agents, ticketing and boarding machines, additional landing slots and gates at airports, and greater numbers and variety of aircraft can provide increased flexibility. This flexibility can be leveraged in improving service quality, such as through minimizing flight cancellations and by reducing the rate of mishandled bags or improving on-time performance. Second, mergers can provide learning opportunities for the merged firm that can positively influence service provision. In a situation where one of the merged carriers has a better service practice, this practice could be replicated throughout the organization post-merger. For example, if an airline with better performance in terms of late arrivals (perhaps due to a superior routing procedure) merges with a carrier with inferior performance, the entire operations may be restructured to mirror the better performing carrier's operations. On the other hand, mergers may also be associated with inefficiencies that reduce service quality. An immediate consequence of a merger is the integration of operations. Challenges associated with process integration post-merger may impact service quality negatively. For instance, it is documented in the popular media that challenges faced by United Airlines post-merger (with Continental) resulted in reservation system failures, shutting down the company's website and disabling airport kiosks. As a result, passengers were stranded as flights were delayed or canceled (Mouawad, 2012). Further, mergers have been shown to negatively affect employee productivity (Siegel and Simons, 2010). The negative impact may be due to downsizing and layoffs and the concurrent increased workloads (Gutknecht and Keys, 1993) or to problems integrating union operations.

Furthermore, mergers may contribute to uncertainties, negatively affecting operating performance; for example, passenger demand on integrated routes may be, at least initially, difficult to forecast, thus resulting in a mismatch between aircraft equipment size and demand.

Through market power, mergers may lead to a deterioration in service quality, especially on overlapping routes or at airports that are widely served by both merging carriers. The merged carrier may reduce its costs through lower expenditures on service provisions, since decreased competition may allow the airline to maintain market share while providing this reduced service (Steven et al, 2012). This argument is supported by the finding that on-time performance is higher in more competitive markets (e.g., Mazzeo 2003, Rupp et al., 2003; Rupp & Holmes, 2006; Prince and Simon, 2009). Further, greater market power may contribute to complacency in the absence of competitive pressures.

These two arguments related to market power and efficiency, together, suggest that the merger-service quality relationship is complex. From the efficiency argument, a merger may lead to better service quality, especially after an initial phase-in process, while from the market power viewpoint, a merger may lead to lower quality of airline services due to reduced competition. The direct merger-service relationship, therefore, is difficult to predict, *a priori*.

In examining the indirect relationship between mergers and service quality (i.e., mergers --> concentration --> service quality), the first relationship between mergers and concentration is quite evident. Since mergers reduce the number of competitors in the marketplace, they inevitably lead to higher market concentration, at least in the short run.[9] However, the concentration-service quality linkage is less obvious. Market concentration could lead to lower service quality since there will be less competition due to the merger. Along this line, Mazzeo (2003) found that flight delays are more prevalent on concentrated routes. Similarly, Mayer and Sinai (2003) and Brueckner (2002) found that airport concentration is positively related to the length of airline delays. However, concentration reduces complexities that may inhibit operational performance. At an airport, for example, that is highly competitive, many carriers may compete for limited slots, gates, and ground-handling equipment. This competition could lead to sorting and loading delays for checked baggage and potentially to flight delays or other service problems. Therefore, in this case, greater competition (i.e., lower concentration) could lead to poorer service outcomes.

[9] In the longer term, entrants may reduce concentration back to pre-merger levels.

Given the arguments presented above, the merger-service quality relationship is difficult to predict *a priori*. The following research questions are thus investigated:

i. How mergers affect service quality of
   a. Merged airlines;
   b. Other airlines competing with the merged carriers;
ii. How market concentration mediates the merger-service quality relationship; and,
iii. The impact of mergers on service quality beyond the influence of the mediating variable, market concentration.

Further, the effect of mergers on service quality may diminish over time. From an operational perspective, the integration challenges that hinder service quality after a merger may be overcome with experience. It is reasonable to suggest that if service quality decreases post-merger, it may eventually start to improve once systems and processes between the two airlines are fully integrated. From the competition/market power viewpoint, over a prolonged period, competitive pressures may eventually contribute to improved service. Therefore, the next research question is:

iv. How long do the merger effects on service quality last?

To conclude, the merger service quality relationship may be quite complex. Mergers can lead to improved service quality through the efficient use of consolidated resources and reduced operational complexities at airports and/or on routes affected by the merger. On the other hand, through industry concentration and market power, mergers may have a negative effect on service quality as both concentration and market power provide fewer incentives to expend resources on attaining high service quality. The net effect of mergers on service quality is an empirical question, which this study aims to address.

2.3 Model specification, data, and data sources

2.3.1 Model specification and key variables

The basis for the model, as illustrated in Figure 3, is that mergers affect service quality indirectly through market concentration and directly due to potential efficiency or market power factors. Consequently, service quality, as measured by four different metrics, each capturing a specific aspect of service, is the main dependent variable. In addition to market concentration, a number of control variables are included in the model that may affect service provision.

Our model proposes that mergers affect concentration and that market concentration, in turn, impacts service quality. The model suggests, therefore, that market concentration mediates or partially mediates the merger-service quality relationship. The empirical model, therefore, is developed to capture this potential mediating relationship.

My base investigation is conducted at the route level for the service quality variables measuring percent of late flights and flight cancellations. A second investigation is done at the carrier level for the other two variables that are reported for all major US carriers at the national level only, mishandled bags and involuntary boarding denials. The latter two service measures are recorded by airline, quarter and year.

2.3.1.1 Route-quarter direct and indirect (through concentration) effects

To estimate the effect of mergers on both concentration and service quality on the routes affected by mergers, I use a method analogous to a difference-in-difference estimator. To capture the indirect linkage through market concentration hypothesis, two sets of equations, one estimating the effect of mergers on concentration, and the second, the effect of mergers and concentration on service quality, are simultaneously estimated. Equations 1 and 2 represent the empirical model for the estimation of the effects of mergers on market concentration and service on affected routes.

$$hhi_{jk} = \alpha_0 + \alpha_1 merger\_route + \alpha_2 distance + \alpha_3 lcc + \alpha_4 market\_size + \alpha_5 SlotRoute$$
$$\sum_{x=6}^{24} \alpha_x carrier + \sum_{v=25}^{33} \alpha_v year + \sum_{k=34}^{36} \alpha_k quarter \text{.........................(1)}$$

$$service_{jk} = \beta_0 + \beta_1 merger\_route + \beta_2 fittedhhi + \beta_3 distance + \beta_4 lcc$$
$$+ \sum_{x=5}^{28} \beta_x carrier + \sum_{y=29}^{37} \beta_y year + \sum_{k=38}^{40} \beta_k quarter + \varepsilon \text{............(2)}$$

Where *j* and *k* represent route and quarter respectively. Table 2 provides detailed descriptions of all the variables. Additional discussion of key variables is provided below and under each unique model.

The *merger route* variable is the difference-in-difference estimator. To compute this estimator, the dates the mergers occurred must first be determined. Based on available records, the Northwest-Delta merger was legally completed on December 31, 2009, the United-Continental merger on October 1, 2010, and the Southwest-Air Tran merger was completed on May 2, 2011. Since I use quarterly data in the analysis, the quarter immediately after the merger quarter is determined as the first post-merger period. For example, the Northwest-Delta merger was finalized on the last day of December of 2009. Therefore, first quarter of 2010 is the first post-merger quarter. Similarly, the 4th quarter of 2010 is the first post-merger quarter for the United-Continental merger and the 3rd quarter of 2011 is the first post-merger quarter for Southwest-Air Tran merger.

Although there is an argument that given the integration issues between carriers, the quarter after the merger is legally completed may not be the best time to reflect the beginning of post-merger activities, I think that it is a reasonable period to use for a number of reasons. First, it is the first full quarter when the merger was legally allowed to occur. Second, I want to capture potential integration problems that occurred following the merger. Third, many integration activities can commence only following the legal merger date.

The *merger_route* variable is estimated as follows: For all the quarters post-merger, the dummy variable is coded 1 for any origin-destination (OD) airport route on which a merged carrier operates. The non-merging-carriers' operated routes, and the pre-merger period routes are effectively the control groups.

The service variables are late flights and flight cancellations, and are calculated manually from the ontime-performance data database. The late flights variable is calculated as one minus the ratio of the number of on-time flights on a specific route to the total number of flights on that route regardless of the carriers working on that route in a quarter. Flights that arrived with delay less than 15 minutes are considered as on-time arrivals. The cancellations variable is calculated as total number of flights that are cancelled on a specific route per every 1,000 flights on that route in a quarter. These service variables, as well as the merger variable, are not airline-route-specific, but only route-specific, the implication being that a merger may affect other carriers operating on the route, even if they were not involved in the merger.

2.3.1.2 Effect on merging carriers' service quality

To estimate the effect of mergers on the service provided by the merging carriers, a different estimator *merger_carrier*, is calculated. This estimator is added to Equation 2 to separate the effects due to the merging carriers from the route effects shared by all carriers operating on routes affected by mergers. This difference-in-difference estimator, *merger_carrier,* is equal to 1 for any merged carrier for all quarters after the merger.

2.3.1.3 Intertemporal effects

To gauge potential intertemporal effects from mergers, a variable, *quarter_after_merger* is introduced that captures the length of time following a merger. This is a time series variable which equals one for the quarter immediately following a merger and unitarily increases for each quarter until the last quarter in the dataset. This variable measures the moderating effect of time on the merger-service quality relationship. These temporal effects are captured by adding this variable as shown in Equation 3 below:

$$service_{jk} = \beta_0 + \beta_1 merger\_route + \beta_2 quarter\_after\_merger + \beta_3 distance + \beta_4 lcc$$
$$+ \sum_{x=5}^{28} \beta_x carrier + \sum_{y=29}^{37} \beta_y year + \sum_{z=38}^{40} \beta_z quarter + \varepsilon \text{............(3)}$$

2.3.1.4 Effects on overlapping routes and hub airport-routes

To estimate the difference between routes that are operated by only one of the two pre-merger carriers and routes with both merging carriers, a new variable, *overlapping_route* is generated and added as indicated in Equation 4. This variable is equal to one post-merger, for all routes with both merging carriers prior to the merger, and zero otherwise.

To estimate the difference in the effects of mergers on routes with at least one of the origin or the destination airports serving as a hub airport and the routes not on O-D routes with no hub airport, a variable, *hub_port_route* is generated and added. Hub airports are those airports in which a dominant network carrier exploits the transfer traffic through coordinated banks of arrivals and departures. Service quality as measured through late flights or delays may be worse at such airports as carriers plan and execute banks of arrivals and departures (Mayer and Sinai, 2002). This variable is equal to one for all carrier-route combinations with at least one of the origin or the destination ports classified as a hub airport. This variable is then interacted with the merger variable to gauge differential effects of mergers on these hub-airport routes.

$$\begin{aligned} service_{jk} &= \beta_0 + \beta_1 merger\_route + \beta_2 overlapping\_route + \beta_3 hub\_port\_route \\ &+ \beta_4 hub\_port\_route * merger + \beta_5 distance \\ &+ \beta_6 lcc + \sum_{x=7}^{29} \beta_x carrier + \sum_{y=30}^{38} \beta_y year + \sum_{z=39}^{41} \beta_z quarter + \varepsilon \qquad (4) \end{aligned}$$

2.3.2 Variables, Data and data sources

A panel dataset of 10 four-quarter years, from the first quarter of 2004 to the last quarter of 2013 is used. I limit the study to mergers of mainline (i.e., non-commuter) carriers between 2004 and 2013.[10] Three mergers that occurred over the study period are investigated: Delta-North West, United-Continental, and Southwest-AirTran mergers.[11]

For the base analyses, data are drawn from the On-Time Performance database from the US Department of Transportation (DOT). This database consists of information on all flights including estimated and actual departure and arrival times; delays in minutes (i.e., the difference between scheduled and actual movements); indicators for flights that were canceled; and reasons for delays and cancelations on all origin-destination (OD) routes. These data are used to create variables for mergers, concentration, and the service metrics: late flights and cancellations.

At flight level, the data exceed 200 million observations for the ten-year period. The data are, however, aggregated to route-quarter level, resulting in 253,864 observations for about 6,000 unique routes. Of these routes, about half (3,040) were operated by at least one of the six merging carriers (or 3 post-merger carriers). Given that the analysis is conducted in the

[10] Since commuter carriers operate as contract carriers for mainline airlines, they are not free to determine their own service levels.

[11] The US Airways-America West merger occurred too early in the dataset to obtain significant before-after merger impacts. Likewise, the American Airlines-US Airways merger occurred too late in the data collection period.

context of treatment evaluation models, I perform tests to show that the merger carriers and the non-merger carriers are comparable. First, the means of delayed flights of the two samples are compared using a simple t-test, and the results show that there is no significant difference between the two groups ($p > .2$). I also compared the means of the route distance between the groups, as well as market size variables, and found the two groups to be comparable.

Table 2 provides brief descriptions of the key variables in the model. (More detailed descriptions are provided in the text in the following sections.) Tables 3 and 4 provide descriptive statistics for the variables in the study as a whole (Table 3) and by specific airline (Table 4). The HHI statistics indicate that routes are quite concentrated with an equivalent of two operators with equal market shares per route, as shown in Table 3. On a typical route, a carrier is late 22% of the time and 15 flights are canceled for every 1,000 operations.

Table 2 - Variable definitions and operationalization

Variable	Definition
Dependent variables	
Service	The major dependent variable investigated. Four different service variables are used
Late flights	The overall percentage of flights late calculated as 1-the percentage of flights arriving within 15 min of scheduled time on a route in a quarter.
Cancellations	The overall number of flights canceled on a route in a quarter per every 1,000 flights
Lost bags	The number of mishandled baggage reports per every 100,000 passengers in a quarter per carrier. These include damaged baggage, pilfered baggage and lost baggage.
Involuntary boarding denials	The number of passengers per 100,000 passengers who are involuntarily denied boarding by a carrier per quarter.
Independent variables	
Mergers	The main explanatory variable investigated. Full variable explanation is given in the text.
Distance	The origin-destination distance as reported in the Ontime performance database. It is designed to capture the effect of flight length on service quality. This is also a carrier level control variable.
LCC (Low cost)	It is a dummy variable which equals 1 if an airline is classified as low cost operator. The classification of Dresner, Lin and Windle (1996) is used. This variable captures the association between low cost carriers and service quality. The expectation is that service levels are lower for low cost carriers since fewer resources are used in providing service.
Market_ size	The sum of the population of the metropolitan cities for the origin and destination (OD) airports. It is designed to capture the effect of market size on concentration and service quality.
HHI	The Herfindahl-Hirschman Index, a measure of market concentration. This index is defined as the sum of the squared market shares of all airlines on an origin-destination route. This variable measures the level of competition faced by a carrier across its operating markets.
SlotRoute	SlotRoute is a binary variable that indicates whether one or both OD airports are slot-controlled.

Table 3 - Descriptive statistics (carrier level)

Variable	Mean	Std. Dev.	Min	Max
Late flights_route	21.58	13.73	2.99	39.72
Cancellation_route	15.38	30.37	0.00	1000.00
Late flights_carrieer_route	21.23	13.66	2.00	18.54
Cancellations_carrier_route	14.87	40.18	0.00	1000.00
HHI	0.49	0.10	0.11	1.00
Distance	833.17	633.45	372.87	1447.51
Market size	1250.00	3640.00	1.30	14000.00

Table 4 - Mean values of the customer service and concentration variables by carrier

Carrier	Late flights	Cancellation	HHI	Distance
Endeavor Air	0.2	20.96	0.57	491.24
American Airlines	0.22	13.45	0.58	1211.09
Aloha Airlines	0.11	8.06	0.71	1319.67
Alaska Airlines	0.16	8.34	0.64	1251.84
JetBlue Airways	0.24	11.16	0.61	1253.01
Continental Air Lines	0.23	5.97	0.64	1224.95
Delta Air Lines	0.18	7.35	0.49	1069.35
ExpressJet Airlines	0.24	23.76	0.56	524.33
Frontier Airlines	0.24	4.87	0.51	951.13
AirTran Airways	0.2	6.26	0.54	854.02
Hawaiian Airlines	0.15	1.26	0.66	1804.62
Envoy Air	0.24	28.19	0.59	534.34
Spirit Air Lines	0.27	15.28	0.49	985.67
Northwest Airlines	0.23	8.23	0.63	893.31
PSA Airlines	0.3	23.35	0.58	527.98
SkyWest Airlines	0.21	17.21	0.62	566.05
AirBridge Cargo Airlines Limited	0.24	14.11	0.56	632.22
ATA Airlines	0.29	5.41	0.46	1810.72
United Air Lines	0.21	10.8	0.5	1295.13
US Airways	0.2	8.97	0.55	1027.18
Virgin America	0.17	5.44	0.39	1733.13
Southwest Airlines	0.19	5.7	0.69	855.34
ExpressJet Airlines	0.22	18.62	0.56	600.24
Mesa Airlines	0.21	23.3	0.62	499.41

2.4 Results and Discussions

2.4.1 Direct and Indirect Effects of Mergers on Service Quality

Our first model is constructed to show how mergers affect service quality directly and indirectly through market concentration. In order to separate out the direct and indirect effects, I first estimate a concentration equation (Equation 1), and then use the fitted values for concentration as an explanatory variable in a second regression (Equation 2) on service. The variable, *SlotRoute*, is used to identify the first equation. It equals 1 for all routes with DCA, JFK, LGA and EWR (i.e., the federal slot-controlled airports) as departure or arrival points. Slot control routes are typically congested, with the slot allocation limiting airport access (Dresner et al., 2002; Hofer et al., 2008). Since there are two different dependent variables measuring service which may have correlated error terms, the SURE (Seemingly Unrelated Regression Equations) model is adopted for the second stage analysis.

Table 5 provides pairwise correlations between the variables in the dataset.

Table 5 - Pairwise correlation between variables

	1	2	3	4	5
Merger_route (1)	1.00				
Cancellations_route (2)	-0.11	1.00			
Lateflights_route (3)	-0.10	0.19	1.00		
Lowcost (4)	0.23	-0.15	-0.04	1.00	
Distance (5)	0.15	-0.20	0.02	0.08	1.00

Note that mergers are negatively correlated with service quality variables, late flights and flight cancellations. Regression results showing the direct and mediating effects of mergers on service quality are presented in Table 6. Three different models are presented. Model 1 establishes a relationship between mergers and market concentration (HHI). In Models 2 and 3, the two service quality measures are regressed on the route merger dummy variable, together with the fitted concentration measure.

In Model 1 (corresponding to Equation 1), the merger coefficient is positive and significant confirming a positive relationship between mergers and market concentration, at least in the immediate periods after mergers.[12] In other words, concentration increases on routes with merging carriers after the merger occurs. From the results presented in Model 2, the percentage of late flights increases after mergers (positive relationship), and the resulting market concentration further increases the percentage of late flights. Mergers, therefore, lead to increases in percentage of late flights on affected routes.

On the other hand, mergers have a direct negative impact on flight cancellations (i.e., fewer cancellations), as shown by the results of Model 3. Indirectly, however, mergers result in

[12] The period after merger variable shows that the effect diminishes over time.

higher route concentration and route concentration is associated with higher numbers of flights cancelled. As indicated below, the indirect effect overwhelms the direct effect, leading to an overall increase in flight cancellations following a merger. Together, Models 1 through 3 clearly show the partial mediating effect of market concentration on the merger-service quality linkage, supporting the hypotheses.

Table 6 - Effects of mergers on service provision on OD routes with mediating effects of concentration

Variable	Model 1 (HHI)	Model 2 (Lateflights_route)	Model 3 (Cancellations_route)	Model 4 (Lateflights_route)	Model 5 (Cancellations route)
Merger_route	0.063*** (0.001)	0.014***	-2.116***	0.007***	0.017 (0.232)
Quarter_after_merger	-0.009***	-	-	-	-
HHI (fitted)	-	0.019** (0.009)	77.431***	0.072***	60.99***
Merger_carrier	-	-	-	0.007***	-2.079**
Distance	-0.0002**	0.00002***	0.006*** (0.00002	0.00002***	0.003***
Market_size	2.90E-09***	8.34E-09***	1.70E-06***	8.10E-09***	1.77E-06***
LCC	0.167*** (0.003)	0.043***	-20.88***	0.042***	-18.20**
SlotRoute	0.003***	-	-	-	-
Intercept	0.648*** (0.003)	0.21*** (0.006)	-24.483**	0.173***	-13.79**
Carrier, **Year and quarter dummy variables included**					
R-Squared	0.33	0.29	0.37	0.29	0.37
F-stat/Chi-	1855.95	19185.3	57781.97	19268.0	48142.6
Prob>F/P-Value	0	0	0	0	0

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively

Table 7 illustrates the marginal effect of a merger of (non-low-cost) carriers on delayed flights and cancellations. It is assumed that the pre-merger carriers are operating on a route with the equivalent of four carriers with equal shares, are serving origin-destination airports from cities with a combined population of 2,024,711, and are operating on a route at the mean stage length of 833 origin-destination miles. I simulate the impact of a merger using the results of Models 2 and 3 from Table 6. Pre-merger, the estimated percent of late flights for the carriers is 24% with 4 cancellations out of every 1000 flights on the route. After the merger, concentration increases to the equivalent of three competitors with equal shares. In this case, the merger results in an 8% increase in late flights from 24% to 26% and a 50% increase in cancelled flights from 4 to 6 per thousand flights.

Closely looking at the results reveals further interesting findings. About 90% of the deterioration in delayed flights is due directly to mergers and about only 10% is due to the resulting increased concentration. Moreover, the entire increase in cancelled flights can be attributed to the indirect impact of mergers through the mediating variable, market concentration.

Table 7 - Marginal effect of mergers and HHI on Late flights

Merger	HHI	Stage length	Market size	Low-cost	Percent late	Cancellations
0	0.25	833	2024711	0	0.24	4.00
1	0.313	833	2024711	0	0.26	6.00

The above results show that service quality, on average, deteriorates after a merger for all carriers operating on the affected route and that the effect is partially due to the resulting increase in concentration. The effect of increased route concentration post-merger on both late flights and cancellations impact all carriers on the route. On the other hand, potential inefficiencies resulting from the merger should have the greatest impact on the carriers involved in the merger. To examine this impact, I add the carrier-route specific merger variable to the model (Equation 2). The results are shown in Models 4 and 5 in Table 6. The two merger coefficients in Model 4, sum to the single merger coefficient in Model 2 and the two merger coefficients in Model 5, sum to the single merger coefficient in Model 3. The results indicate that the impact of mergers on late flights is about half due, specifically, to the carrier that merged and half due to the operations on the route, in general. However, the net increase in cancellations is due to the greater concentration in the market, and the complete impact can be attributed to the merged carriers alone.

2.4.2 Intertemporal effects

The effect of mergers on service over time is demonstrated in Table 8. Models 6 and 7 show how the impact of mergers on service quality change over time. Model 6 indicates that the negative impact of mergers on percent of late flights (i.e., more late flights) fades over time, given the negative coefficient for the temporal variable. In the cancellations equation (Model 7), the coefficient for the temporal variable is also significant and negative showing that the negative impact of mergers on service quality (i.e., cancelled flights) decreases over time as well. Interestingly, the coefficient for the cancellation variable becomes positive and significant after the addition of the temporal variable. This clearly shows that in the immediate period following mergers, cancellations increases.

In Table 9, I show the results of the model estimating the period of the negative impact of a merger. A typical merger results in a net increase of 3 cancellations for every 1000 flights. However, by the fifth quarter, the marginal effect is completely reversed and by the sixth quarter, cancellations are lower compared to the pre-merger level. The negative effects on percent of late flights lasts longer. After the initial jump in percentage of late flights, there is a gradual improvement each quarter thereafter, but the effect can persist well beyond two years after the merger is completed.

Table 8 - Diminishing effects of mergers over time and hub airports and overlapping route effects.

Variable	Model 6 lateflights	Model 7 Cancellations	Model 8 lateflights	Model 9 Cancellations	Model 10 lateflights	Model 11 Cancellation
Merger_route	0.015*** (0.001)	2.77*** (0.203)	0.015*** (0.001)	2.792*** (0.203)	0.032*** (0.002)	2.921*** (0.243)
Quarter_after_merger	-0.0008** (0.0004)	-0.679*** (0.013)	-0.0008** (0.0004)	-0.678*** (0.012)	-0.0008 (0.0007)	-0.683*** (0.013)
Overlapping_route	_	_	0.009*** (0.002)	-0.413 (0.306)	_	_
Hub_port_route	_	_	_	_	0.015*** (0.001)	1.130*** (0.228)
Hub_port_route*	_	_	_	_	-0.019*** (0.002)	-0.322 (0.310)
Distance	0.00001*** (0.000)	-0.006*** (0.000)	0.00001*** (0.0000)	-0.006*** (0.000)	0.00001*** (0.000)	-0.006*** (0.000)
Market_size	8.41E-09*** (1.46E-10)	1.99E-06*** (2.26E-08)	8.41E-09*** (1.46E-10)	1.99E-06*** (2.26E-08)	8.41E-09*** (1.46E-10)	1.98E-06*** (2.26E-08)
LCC	0.057*** (0.009)	-11.755*** (2.122)	0.057*** (0.009)	-10.26*** (1.357)	0.056*** (0.009)	-11.792*** (2.122)
Intercept	0.220*** (0.002)	25.692*** (0.288)	220*** (0.002)	25.687*** (0.288)	0.220*** (0.002)	25.687*** (0.288)
Carrier, Year and quarter dummy variables included						
R-Squared	0.3	0.38	0.33	0.39	0.33	0.39
F-stat/Chi-	19185.3	47782	19206	47784.2	19215.1	47810.4
Prob>F/P-	0	0	0	0	0	0

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively

Table 9 - Marginal Effect of mergers and time after mergers on late flights, and cancellations

Merger	Quarter after merger	Percent late	Cancellations
0	0	0.00	0.00
1	1	0.014	2.77
1	4	0.012	0.054
1	6	0.010	-1.304

2.4.3 Effects on overlapping routes and hub ports

To estimate the difference in merger impacts between routes that were operated by only one of the merging carriers during the pre-merger period and routes where both merging carriers operated, a variable, *overlapping_route* is included in the estimation. The regression results are presented in Models 8 and 9 in Table 8. From Model 8, it can be seen that there is increased impact of mergers on late flights when both pre-merger carriers operated on a route. On the other hand, the effect of mergers on flight cancellations is the same, regardless of whether one or both of the pre-merger carriers operated on a route.

To estimate the difference in merger impacts between routes with at least a hub airport and routes with no hub airports, a variable, *hub_port_route*[13] is included in the estimation together with its interaction term with the merger variable. The regression results are presented in Models 10 and 11 in Table 8.

[13] A list of airports considered as hub airports in this study is given in Appendix 1.

From Models 10 and 11, it can be seen that both late flights and cancellations are worse on routes with a hub airport. This is in line with prior studies (e.g. Mayer and Sinai, 2002). After mergers, however, there is a decrease in late flights when any of the origin or destination airports is a hub airport; that is, the effect of mergers on late flights is attenuated by hub airport operations. The effect of mergers on flight cancellations, however, is unaffected by hub airport operations.

2.4.4 Control variables

For the control variables, across all the models, the distance coefficient is generally significant and positive for the late flights estimations (i.e., longer routes have worse on-time performance), and positive and significant for cancellations (i.e., longer routes have more cancellations). Generally, low-cost carriers have more late flights, and perhaps surprisingly, cancel fewer flights. Market size appears to lead to more late flights and more cancelled flights.

2.4.5 Robustness checks

There are at least two potential factors that could impact the findings. First, the dependent variable is calculated at the route level and therefore is not *airline*-route-specific (only route-specific), the implication being that a merger affects all carriers operating on the route. However, as demonstrated above, the impact of a merger may not be shared equally among all carriers on a route. Second, there are many potential reasons for late flights, including weather related, security, and air traffic control. We, however, used all delays in the calculation of the late flights, and it is clear that some of these late flights are due to conditions outside the control of the carriers.

In order to address the first issue, I calculated different measures for late flights and cancellations as follows: late flights are re-calculated as one minus the ratio of the number of on-time flights *for a specific carrier-route combination,* to the total number of flights *on that carrier-route combination* in a quarter, and the cancellations variable is calculated as total number of flights that are cancelled in a quarter, *on specific route by a carrier* per every 1,000 flights. These service variables, *lateflights_carrier_route*, and *cancellations_carrier_route*, are therefore airline-route specific and are estimated using Equation 5, below:

$$service_{ijk} = \lambda_0 + \lambda_1 merger\_route + \lambda_2 merger\_carrier + \lambda_2 distance + \lambda_4 lcc$$
$$+ \sum_{x=5}^{28} \lambda_x carrier + \sum_{y=29}^{37} \lambda_y year + \sum_{z=38}^{40} \lambda_z quarter + \varepsilon \text{.............(5)}$$

The regression results are presented in Table 10.

Table 10 - Effect of mergers on carrier-route specific service levels

	Lateflights_carrier_route	Cancellations_carrier_route
Merger_route	0.010***	0.460*
	(0.001)	(0.260)
Merger_carrier	0.004***	-2.358***
	(0.0001)	(0.129)
Distance	0.00001***	-0.005***
	(0.0000)	(0.0001)
Market_size	7.91E-09***	1.89E-06***
	(1.37E-10)	(2.76E-08)
Lowcost	0.046***	-15.105***
	(0.014)	(1.745)
Intercept	0.214***	27.946***
	(0.002)	(0.343)

Carrier, Year and quarter dummy variables included

The results closely mirror those found in the base models. The marginal merger effect on late flights is about 0.014 or close to a two-percentage point increase in late flights. In addition, the marginal impact of mergers on cancellations is about 3 per 1000 flights. The results confirm that flights operating on merger-affected routes, on average, face service deterioration which fades over time.

In order to address the second point, I re-calculate the late flight variable by cause of delay, separated into: weather-related, carrier-related, and security-related, as reported in the on-time performance database. The regression results are presented in Table 11.

Table 11 - The effect of mergers on late flights by cause of delay

	Model 12 weather_latefl ights	Model 13 carrier_latefl ights	Model 14 security_latefl ights
Merger_route	0.004*** (0.0002)	0.011*** (0.001)	-0.0001** (0.0005)
Distance	-0.000003*** (0.000)	8.21E-06*** (2.70E-07)	-1.31E-07*** (2.21E-08)
Market_size	9.92E-10*** (3.19E-11)	1.73E-10*** (7.61E-11)	1.34E-10*** (6.23E-12)
LCC	-0.010** (0.003)	-0.010*** (0.001)	0.002** (0.0006)
Intercept	0.0168*** (0.0003)	0.084*** (0.001)	0.001*** (0.000)
Carrier, Year and quarter dummy variables included			
R-Squared	0.21	0.51	0.11
F-stat/Chi-squared	27059.77	114611.91	4378.24
Prob>F/P-Value	0	0	0

The merger coefficients from Models 12, 13, and 14 sum to the merger coefficient in Model 2. Not surprisingly, carrier-related causes account for most of the impact of mergers on flight performance. However, there is a significant positive relationship between mergers and weather-related delays. A possible explanation for this result is that given their market power, merged carriers may use weather issues as a cover for reduced service quality.

2.4.6 Effects on mishandled bags and involuntary boarding denials

To estimate the effect of mergers on two additional service variables, mishandled bags and involuntary boarding denials, a second dataset is constructed at the carrier level.[14] A panel

[14] Both mishandled bags and involuntary boarding denials are reported only at carrier levels.

dataset of 10 four-quarter years, from the first quarter of 2004 to the last quarter of 2013 is used. The service data are from the Air Travel Consumer Report (ATCR), a report published monthly by the Department of Transportation (DOT). Data are collected on the 13 largest US airlines that have consistently appeared in the ATCR. These thirteen carriers include the six that participated in the three mergers analyzed for this research.

For this analysis, the merger variable is at the carrier level and is calculated as follows: for all quarters, post-merger, a dummy variable is set equal to 1 for those observations involving merged carriers. This method is analogous to the difference in difference method as both merging and non-merging carriers, and pre- and post-merger time periods are included in the analysis.

The service variables are calculated as follows: Involuntary boarding denials is the number of passengers per 100,000 passengers that are involuntarily denied boarding by a carrier per quarter; mishandled bags is the number of mishandled baggage reports per every 100,000 passengers in a quarter per carrier (including damaged baggage, pilfered baggage and lost baggage). In total, the sample includes 440 observations. An equation that mirrors the disaggregated data equation is estimated, as given below:

$$service_{ijk} = \beta_0 + \beta_1 merger + \beta_3 stagelength + \beta_4 Market\_size + \beta_5 lowcost\ carrier$$
$$+ \sum_{y=6}^{17} \beta_y carrier + \sum_{y=18}^{28} \beta_y year + \sum_{y=29}^{32} \beta_y quarter + \varepsilon \text{............(6)}$$

Regression results are presented in Table 12. From Models 15 and 16, both mishandled bags and involuntary boarding denials increase in the immediate period after a merger by approximately an additional bag and passenger respectively. Whereas this effect may be eroded by the seventh quarter after mergers for mishandled bags, boarding denials may persist for several additional quarters.

Table 12 - Carrier level regression results

	Model 15 Mishandled Bags	Model 16 Involuntary boarding denials
Merger_carrier	1.103*** (0.180)	0.528*** (0.104)
Quarter_after_merger	-0.161** (0.080)	-0.033* (0.018)
Stagelength	-0.001** (0.0004)	0.001*** (0.0003)
Market_size	2.83E-07*** (8.48E-08)	-2.03E-07*** (4.90E-08)
Lcc	-0.799*** (0.168)	-0.047 (0.097)
Intercept	4.421*** (0.345)	634*** (0.200)
Carrier, Year and quarter dummy variables included		
R-Squared	0.67	0.33
F-stat/Chi-squared	481.81	96.12
Prob>F/P-Value	0	0

2.4.7 Conclusions and Implications

Mergers affect service quality in different ways. Directly, mergers may improve quality through the efficient use of resources, but may also lead to lower quality through the exercise of market power and consolidation challenges. Indirectly, through market concentration, mergers may result in lower quality, not just for the merged carrier, but also for other carriers operating on affected routes due to the reduced competition. The final effects of mergers on service quality may be difficult to predict *a priori*. In this essay, I examine how mergers affect service quality in the airline industry. I examine three US domestic mergers that have occurred since 2004 and estimate the relationship between four service variables and mergers at both route and carrier levels.

For all service variables, the results indicate that mergers have contributed to service deterioration in the immediate years following the mergers. The direct effects of mergers on percent of late flights, flight cancellations, mishandled bags, and involuntary boarding denials are unequivocally undesirable. Further, the resulting increased market concentration from mergers also has an undesirable impact on both late flights and cancellations.[15] The results also show that the impact of mergers on these service measures fade away for both flight cancellations and mishandled bags after the sixth quarter following the merger. However, deteriorations in both late flights (on-time performance) and involuntary boarding denials persist well into the third year after mergers.

[15] This effect is also supported for both mishandled bags and involuntary boarding denials, though not reported here.

The findings that service quality is negatively impacted by both mergers and market concentration is significant for several reasons. Academics and public authorities, in examining merger effects, often concentrate on the impact on airline fares. The study shows that mergers, and the resulting increased concentration, may lead to carriers providing lower quality service to the consumers. The results indicate that airlines benefit by operating in less competitive markets in terms of being able to provide lower service quality, presumably at a lower cost. Consequently, airlines can profit by merging and operating in highly concentrated markets. Thus, the recent US merger wave (Delta and Northwest, United and Continental, Southwest and AirTran, and American Airlines and US Airways) could have contributed to the higher industry profits recorded in recent years. Note that the potential anticompetitive practices of the carriers, post-merger wave, have been probed by the US Department of Justice. It must also be noted however that, it may be that the level of service provided by carriers before the merger was uneconomic and that with the mergers, carriers are now providing service closer to optimal levels.

Although most of the negative impacts of mergers on service quality seem to disappear in the second year after the merger, increased concentration on a route, post-merger, may persist. In this case, the negative indirect effect of mergers may persist even after the direct merger effect is no longer felt. There is a public policy implication in this: that the impact of concentration on service levels should be an important factor when mergers are evaluated.

There are important limitations to the study which point to future research opportunities. First, the impact of mergers on overall societal welfare is still not determined. In addition to impacting service, mergers, of course, may impact fares. Fares may increase due to reduced competition or may be lower due to merger synergies. A study that incorporates both the price and quality effects in its estimation of the effects of mergers on societal welfare would add value to this line of research. Second, the construction of the quarter_after_merger variable restricts the association between periods after the merger and quality to a linear relationship. Future studies can consider alternative measures of this time series variable that would allow nonlinear trends in merger impacts.

2.5 Appendix 1: Hub airports

To calculate the hub_port_route variable, a list of airports considered as hub ports is needed. I therefore conducted a thorough literature search as well as search over the web including specific airline websites to determine the airports that are used for hub operations for the major carriers. Some LCCs do not rely on hub operations, and are therefore not considered for this purpose. Below are the lists of airports used as hub airports.

Table 13 - List of airports considered as hub airports.

Carrier	Carrier Code	Airport Code	Airport	
American Airlines	AA	DFW	Dallas Ft. Worth	
American Airlines	AA	JFK	NY-JFK	
American Airlines	AA	LAX	Los Angeles - LAX	
American Airlines	AA	MIA	Miami	
American Airlines	AA	ORD	Chicago O'Hare	
American Airlines	AA	STL	St. Louis	2004-2009
Alaska	AS	SEA	Seattle	
Continental	CO	CLE	Cleveland	
Continental	CO	EWR	Newark	
Continental	CO	IAH	Houston	
Delta	DL	ATL	Atlanta	
Delta	DL	CVG	Cincinnati	
Delta	DL	DFW	Dallas Ft. Worth	2004
Delta	DL	DTW	Detroit	AFTER Merger
Delta	DL	JFK	New York - JFK	
Delta	DL	LGA	New York - LGA	
Delta	DL	MEM	Memphis	AFTER Merger
Delta	DL	MSP	Minneapolis	AFTER Merger
Delta	DL	SLC	Salt Lake City	
AirTran	FL	ATL	Atlanta	
Northwest	NW	DTW	Dallas Ft. Worth	
Northwest	NW	MEM	Memphis	
Northwest	NW	MSP	Minneapolis	
United Airlines	UA	CLE	Cleveland	AFTER Merger
United Airlines	UA	DEN	Denver	
United Airlines	UA	EWR	Newark	AFTER Merger
United Airlines	UA	IAD	Washington-Dulles	
United Airlines	UA	IAH	Houston	AFTER Merger
United Airlines	UA	LAX	Los Angeles - LAX	
United Airlines	UA	ORD	Chicago O'Hare	
United Airlines	UA	SFO	San Francisco	
US Airways	US	CLT	Charlotte	
US Airways	US	PHL	Philadelphia	
US Airways	US	PHX	Phoenix	

CHAPTER 3

FARE DEBUNDLING AND SERVICE QUALITY

In this chapter I investigate the effects of the imposition of baggage fees (BF, hereafter) on airline on-time performance as assessed through late-flights. The unbundling of BF from the base fare, since its inception by the low-cost carrier, Spirit Airlines, in 2007, has become a popular strategy in the industry. The annual revenue from fees has increased substantially from 464 million USD in 2007, to 3.8 billion USD in 2015 (Bureau of Transportation Statistics), accounting for about 2.1 percent of total operating revenue across the industry. At present Southwest is the only carrier that does not charge any fees for first and second checked-in baggage[16].

There is a dearth of literature on the effects of the imposition of BF by air carriers. A number of studies, however, have looked at the linkage between the imposition of fees and stock values (Barone, et al., 2012), ticket prices (Henrickson & Scott, 2012; Brueckner, et al., 2015), and air passenger demand (Scotti & Dresner, 2015). The literature, however, does not adequately address the linkage to operational service quality such as flight delays.

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[16] Southwest, however, like all other carriers, charges for more than two checked bags and also for overweight bags.

The association between charging fees for checked-in bags and delayed flights is not straightforward and consequently not known a priori. One might argue that the increase in carry-on bags in order to avoid paying the extra fees, would lead to security and boarding delays, and thus have a negative effect on flight delays. The imposition of BF, however, may lead to increase in on-time performance, or lower flight delays. Fees are in effect, an increase in the total flight fares (Brueckner, et al., 2015). As a result, the imposition of fees would lead to a drop in the number of air travelers (Scotti & Dresner, 2015). This would result in fewer travelers, shorter security and boarding lines, and fewer carry-on bags to be loaded in aircraft overhead bins. Further, fewer checked-in bags means shorter airport-side processing time required for screening and loading bags onto aircrafts. Consequently, carriers may depart on-time more often in relation to "bags fly free" policies. As can be seen in Figure 4, late flights were on an increasing trend between 2003 and 2007. In 2008, there is a sharp drop in late flights; and in 2008, most airlines implemented BF policies. This coincidence anecdotally suggests that there is a positive correlation between BF and on-time performance.

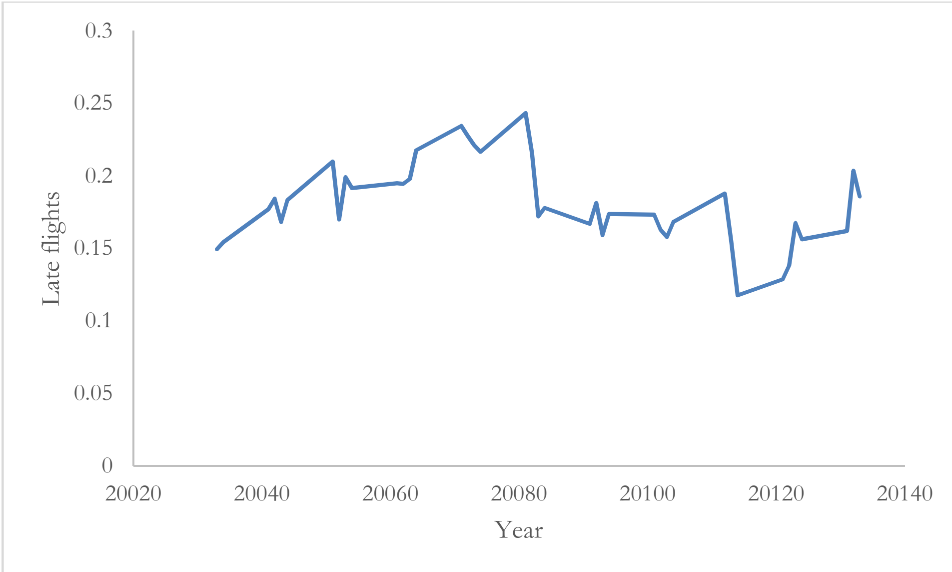

Figure 4 - Time series of late flights for an average carrier

On-time performance is a major parameter for evaluating operational efficiency of airlines; is directly associated with customer satisfaction; and is positively correlated with profitability (Dresner & Xu, 1995; Steven, et al., 2012; Mellat-Parast, et al., 2015) . The potentials for the imposition of fees on checked-in bags to influence on-time performance, and the importance of the issue of delayed flights in terms of customer satisfaction and consequently financial performance, makes this topic extremely relevant and interesting for research. Literature search in this area turned up only two papers that have looked at this linkage (Scotti, et al., 2016; Nicolae, et al., 2016). My research builds on these seminal works by looking at nuances otherwise ignored by them.

The rest of the Chapter is organized as follows: Section 3.1 discusses the literature on the imposition of fees in the airline industry. The literature review is followed by a hypotheses section (3.2) which discusses the conceptual research questions. Section 3.3 discusses the research methodologies and the data used for the analysis, while Section 3.4 presents the findings. In the last section (3.5), conclusions are presented, along with research and managerial implications.

3.1 Literature Review

There is a dearth of literature linking BF to flight delays performance. However, researchers have investigated several aspects of imposing BF on checked-in bags by carriers. Barone, et al., (2012) studied the reactions of the stock market to the announcement of the imposition of fees. The authors suggested that initial announcements of change in fees policy lead to negative abnormal returns for the announcing firms as well as their competitors. However, they found that a subsequent increase in price is associated with positive financial return and stock price performance.

Henrickson & Scott, (2012) looked at the relationship between the imposition of BF and the total ticket prices paid by air travelers. They found that airline ticket prices have a negative relationship with BF. Hence it can be concluded that airlines substitute fees for higher fares. The authors further found that Southwest which does not charge for checked-in bags increased fares on routes where it competes with the legacy carriers after they imposed fees. According to Brueckner, et al., (2015), however, the imposition of BF leads to an average airfare decrease by less than the baggage fee itself; hence, passengers checking-in baggage have to pay a higher full price. A complementary study by Scotti & Dresner, (2015) suggested that charging fees causes passenger dissatisfaction leading to loss of customers. On an average route, the authors concluded that an increase in fees leads to decrease in passenger demand.

More relevant to the studies are studies of Scotti, et al., (2016) and Nicolae, et al., (2016). In their paper, Nicolae, et al., (2016) found that after implementation of baggage fees, there was an improvement in the on-time performance of airlines measured through their departure delays. In Scotti, et al., (2016), the authors studied the relationship between fees and operational performance and customer satisfaction. Their estimation results show that a fee is negatively correlated with the rate of mishandled baggage, and positively with on-time performance. These studies, however, have limitations that may affect their findings. Nicolae, et al., (2016) used departure delays to measure on-time performance. However, it might be of more value to study arrival delays since it would have more impact on air passengers. Moreover, they looked at data spanning over only two years after the imposition of baggage fees. The effect of baggage policy on on-time performance may go beyond this limited time period. Scotti, et al., (2016) used data aggregated at carrier level. There is, however, heterogeneity across routes in terms of the extent of competition, the composition of the air travelers, and consequently airline operations.

The scarcity of existing literature on the topic, and the inherent limitations of Scotti, et al., (2016) and Nicolae, et al., (2016), suggest that further studies are needed to expand the understanding of the effects of ancillary fees on operational performance. This study, therefore, fills a gap in the literature by focusing on route level effects, and expanding the study horizon to many quarters post fees impositions. The study also adds contexts to the fees-late flights linkage. Ours is the first study that investigates the moderating influences of the presence of low-cost carriers and hubs on the route, the concentration of the route, and the effect of leisure routes. Further, the study is the first to separate the direct effects from the indirect effects through air ticket prices and demand for air travel.

3.2 Conceptual background and research questions

The findings from the literature suggest two fees-imposition-flight delays relationships. There are conceptually indirect relationships via ticket prices, and demand, and a direct relationship through airport side operational efficiency on the one hand, and screening and boarding inefficiency on the other hand. Figure 5 shows a theoretical framework for these relationships.

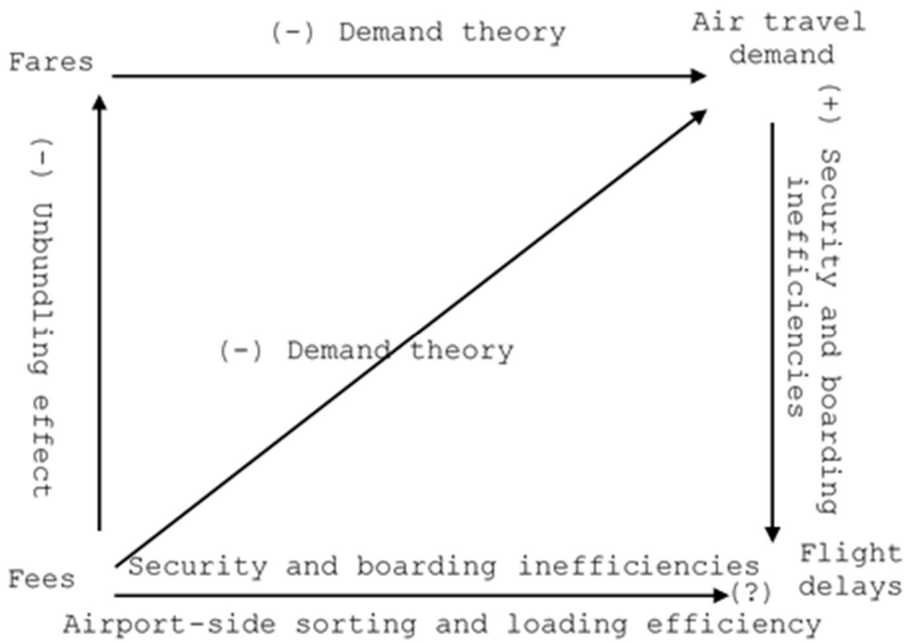

Figure 5 – BF-Flight linkage, Research Model

Imposition of fees can affect flight delays directly in different ways. Fees can directly lead to an increase in flights delays (a decrease in on-time performance). There are several logical reasons for this supposition. As passengers are charged for checked-in baggage, economic theory suggests a rational traveler would avoid paying extra fees where possible. This would result in more passengers opting for carry-on bags[17](Scotti et al., 2016; Nicolae et al., 2016). Further, these carry-on bags would become as big and heavy as is allowed by the carrier to

[17] Spirit Airlines would be an exception in this case since it is the only carrier which charges for carry-on bags as well as checked bags.

accommodate more load. The results are longer security checks and consequently overcrowding of the overhead bins, slowing down boarding and consequently delaying departures. According to Senators Markey and Blumenthal, checkpoints that serve carriers charging fees see 27 percent more roller-bags than those serving carriers that don’t charge any extra fees for checked bags (Siemaszko, 2016). Hence, imposition of fees could lead to more flight delays.

The rule regarding the number of bags allowed on cabins though, remains one bag in the overhead bin, and a smaller one under the seat in front of the traveler. The imposition of fees therefore may only have a limited effect on carry-on bags as even prior to it, passengers were allowed the same number of one plus one bags. While the number of carry-on bags per flight may remain relatively unchanged therefore, charging fees for checked baggage may cause a fewer number of bags checked in due to natural consumer behaviour. Consequently, loading the lower number of checked-in bags on the flight would be more efficient and less time consuming which would lead to on-time flight departures. Thus, fees could directly improve flight delays of carriers. An additional lever by which not checking bags could improve on-time performance is that if a passenger misses a flight, there is no need to bag-match and remove that passenger's luggage from the aircraft after boarding has already occurred.

These two arguments related to security and boarding inefficiencies, and airport-side loading efficiencies, suggest that the fee-flight-delays relationship is intricate. From the former hypothesis, fees result in higher flight delays. From the airport-side loading efficiency argument, fees result in improved on-time flight performance. The direct fee imposition-flight delays linkage therefore, is difficult to predict a priori.

The indirect relationship (i.e., fees-passenger demand-late flights), is theoretically, also quite convoluted and difficult to predict. The unbundling of the BF from the airline ticket price decreases the base airfare (Henrickson & Scott, 2012). This would increase passenger demand especially those that can avoid BF by not checking in any bags. An increase in the number of passengers would mean more checked-in and carry-on bags making the loading and boarding process more time consuming. As a result, flights would be more likely to be delayed.

On the other hand, the imposition of BF leads to an increase in total travel cost of passengers who have to check bags (Brueckner, et al., 2015). Moreover, paying for check-in bags, which does not create any extra value for passengers, could lead to customer dissatisfaction. According to appraisal theory, consumers' appraisal of ancillary fees like the airline industry's fees, is affected by the fact that when certain pricing policies which had become "rules of process" are violated consumers assess them as unfair (Maxwell, 2002; Tuzovic, et al., 2014), especially if no value is created in return for the extra fees (Lyn Cox, 2001; Herrmann, et al., 2007). Consumers avoid purchases of products with perceived unfair prices (Xia, et al., 2004). This suggests that there could be a loss of customer or a decrease in passenger demand due to imposition of fees which does not add any value to the passengers' flight experience. Indeed, Scotti & Dresner, (2015) found that the imposition of fees resulted in fewer airline passengers. A decrease in the number of passengers would mean a lower number of checked-in and carry-on bags making the loading and boarding process less time consuming. As a result, flights would be less likely to be delayed.

Further, route specific attributes such as concentration levels, the presence of a low-cost carrier, and hub-port on the route, and delay specific attributes such as security or weather, can influence the effect of fees on late flights. These nuances are investigated and analyzed as well. In conclusion, the true impact of baggage policy on flight delays of carriers is complex and may even be affected by several underlying factors and moderators.

Based on the above assumptions, the following research questions are therefore investigated:

- How does BF policy, i.e., charging fees for first and second checked bags, by airlines affect the carrier's on-time performance measured through late flights?

- How does BF policy, i.e., charging fees for first and second checked-in bags, by airlines affect total travel cost and consequently air travel passenger demand?
- It is logical to argue that the presence (absence) of a low-cost carrier, which generally offers lower fares, would exacerbate (ameliorate) the effect of fees implementation. Therefore, how does the presence (absence) of low-cost carriers, on a route affect passenger demand and late flights after fees implementation?
- How does passenger demand affect (mediate) the relationship between fees and flight delays of carriers?
- Further, market concentration may play a dampening role on the fees-demand relationship. Because of the lack of alternatives, higher fees may not necessarily result in lower demand. This would diminish the positive indirect effect of fees on late flights. Market concentration may also affect the direct BF-late flights relationship. Therefore, how does route concentration affect (moderate) the net effects of BF policy on late flights?
- Moreover, since leisure travelers are more likely to carry check-in bags while business travelers have a tendency to travel light with just carry-on bags, the passenger mix might affect the impact of BF policy on flight delays of carriers. Hence, I ask: does the net

effect of BF policy on flights on leisure routes differ from the effect on non-leisure route?

- Given the temporal nature in which customers react to price changes, it is logical to suggest that the changes in demand, if any, due to the imposition of fees would be temporal, especially given the fact that almost all carriers have ultimately implemented the policy. The last research question is therefore, how long does the BF policy effect last on late flights?

3.3 Data, variables, and model specification

3.3.1 Model Specification

On the basis of the theoretical model depicted in Figure 5, I develop three statistical equation models. The models are constructed to show how BF affect late flights directly, and indirectly through air ticket prices, and travel demand. Equation 1 models the impact of imposing BF on yield at carrier-route level. Equation 2 models the impact of imposing BF on passenger demand and Equation 3 models the impact of BF policy on late flights.

$$Yield_{ijt} = \alpha_0 + \alpha_1 Bags\_Fee_{ijt} + \alpha_2 Passengers_{ijt} + \alpha_3 Merger_{ijt} + \alpha_4 Recession\_Control_t + \alpha_5 HHI_{jt} + \alpha_6 Hub_{ijt} + \alpha_7 LowCost_{jt} + \alpha_8 Distance_j + \sum_{x=9}^{19} \alpha_x carrier + \sum_{y=20}^{30} \alpha_y year + \sum_{31}^{33} \alpha_z quarter + \varepsilon_{ijt} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (1)$$

$$Passengers_{ijt} = \beta_0 + \beta_1 Bags\_Fee_{ijt} + \beta_2 Yield_{ijt} + \beta_3 Merger_{ijt} + \beta_4 Recession\_Control_t$$

$$+ \beta_5 Slot\_Route_{jt} + \beta_6 Market\_Size_{jt} + \beta_7 Hub_{Ijt} + \beta_8 Distance_j$$

$$+ \sum_{x=9}^{19} \beta_x carrier + \sum_{y=20}^{30} \beta_y year + \sum_{31}^{33} \beta_z quarter$$

$$+ \varepsilon_{ijt} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots . (2)$$

$$Late\_Flights_{ijt}$$

$$= \gamma_0 + \gamma_1 \; Bags\_Fee_{ijt} + \gamma_2 \; Passengers_{ijt} + \gamma_3 Merger_{ijt}$$

$$+ \gamma_4 Recession\_Control_t + \gamma_5 Block\_Difference_{ijt} + \gamma_6 \, Hub_{ijt}$$

$$+ \gamma_7 LowCost_{ijt} + \gamma_8 Distance_j + \sum_{x=9}^{19} \gamma_x carrier + \sum_{y=20}^{30} \gamma_y year$$

$$+ \sum_{31}^{33} \gamma_z quarter + \varepsilon_{ijt} \dots\dots\dots\dots (3)$$

Where *i, j* and *t* represent carrier, route and quarter respectively.

3.3.2 Variable definitions

Table 14 provides detailed descriptions of all the variables. Additional discussion of the main dependent variable is provided below. Further, additional unique variables, and variants of the main dependent variable are described under each unique subheading.

The *Bags_Fee* variable is a dummy variable. To generate this variable, the dates in which airlines started to charge a fee on second checked-in bag and on first checked-in bag are first determined. If the imposition of baggage fee occurred in the first half of a quarter, that quarter is considered as the first-post fee quarter. If it occurred in the second half of a quarter, the succeeding quarter is considered as the first-post-fee quarter. For example, United Airline, as the first airline[18] among airlines in the database, implemented the fee policy for the second checked-in bag on May 5th, 2008 and for the first checked-in bags on June 13th, 2008. Therefore, second quarter of 2008 is the first post-fee quarter for one free bag policy and the third quarter of 2008 is the first post-fee quarter for non-free bags policy. Table 15 provides the dates for all airlines I use in the database.

[18] Spirit Airline is the very first airline that charged its fees policy. Spirit Airline started to charge the second checked-in bag in February, 2007 and the first checked-in bag in June, 2007. However, since the information about delay for Spirit Airline is not available before 2015, it is inevitably dropped from the analysis.

Table 14 – variable definitions

Variable	Definition
Dependent variable	
Late_Flights	The overall percentage of flights late calculated as 1 - the percentage of flights arriving within 15 min of scheduled time on route j in quarter t for carrier i.
Passengers	It is a measure of air travel demand. It is calculated as the total number of OD route passengers for carrier i in quarter t.
Yield	I operationalized ticket fares as yield, which is calculated as the ticket price divided by the miles flown.
Independent variables	
Bags_Fee	The main explanatory variable investigated. Full variable explanation of the variable, as well as its variations are given in the text.
Control variables	
Leisure	A continuous variable equal to the absolute difference between origin's and destination's average January high temperatures. A measure of a leisure market to differentiate vacation travelers from business ones (Brueckner, et al., 2015).
Hub[1]	It is a binary variable, which takes value one if any of OD airports is a hub for carrier i.
HHI	The Herfindahl–Hirschman Index, a measure of market concentration. This index is defined as the sum of the squared market shares of all airlines on an origin–destination route. This variable measures the level of competition faced by a carrier across its operating markets.
LowCost	LowCost is a binary variable, which takes value one if at least one low-cost carrier operates on route j in quarter t.
Market_Size	The sum of the population of the metropolitan cities for the origin and destination (OD) airports. It is designed to capture the effect of market size on air travel demand, concentration and service quality.
Recession[2]	Recession is a quarterly binary variable controlling for The Great Recession in the U.S., officially lasting from December 2007 to June 2009. It is equal to one from 2008-Q1 to 2009-Q2, otherwise 0
Slot_Route	Slot_Route is a binary variable that indicates whether one or both OD airports are slot-controlled.
Block_Difference	Is the difference between CRS elapsed time and Actual elapsed time of flight in minutes to control for flexibility of flight
Merger	This is a binary variable to control for big merges happened recently. It is equal to one if carrier i merged at time t, 0 otherwise.
Distance	Indicates the distance between origin and destination in miles.

[1]I also used a second binary variable which is equal to 1 if only the origin airport is a hub airport. [2]According to Business Cycle Dating Committee of the National Bureau of Economic Research.

The *Bags_Fee* variable is calculated as a binary variable which equals one for all quarters from the first post-fee quarter of any fees applied, up to twelve[19] quarters after imposition of any fees, otherwise 0[20]. For instance, American Airline imposed its fee policy on May 12th, 2008. So American's *Bags_Fee* variable would be one for the second quarter of 2008, and through the first quarter of 2010, 0 in any other case. This variable is geared towards testing the imposition of fees in general, regardless if the airline allows one free bag to fly.

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[19] Goolsbee & Syverson, 2008 also considered twelve quarters as their study period.

[20] I also used an alternative variable which is equal to 1 for all quarters after the imposition of BF, zero otherwise. The results are robust to the measurement form as they are almost identical to the ones reported here.

Table 15 - Fee Policy Imposition Dates

Airline	Imposition Date (One Free)	One Free Post-Fee Quarter	Imposition Date (Non-Free)	Non-Free Post-Fee Quarter
United Airline	May 5th ,2008	2008-2	June 13th, 2008	2008-3
US Airways	May 5th, 2008	2008-2	July 9th, 2008	2008-3
Northwest	May 5th, 2008	2008-2	Aug 28th, 2008	2008-4
Continental	May 5th, 2008	2008-2	Oct 7th, 2008	2008-4
Delta	May 5th, 2008	2008-2	Dec 5th, 2008	2009-1
American Airline	May 12th, 2008	2008-2	June 15th, 2008	2008-3
American Eagle	May 12th, 2008	2008-2	June 15th, 2008	2008-3
AirTran	May 15th, 2008	2008-2	Dec 5th, 2008	2009-1
JetBlue	June 1st, 2008	2008-3	June 30th, 2015	2015-3
Frontier	June 10th, 2008	2008-3	Nov 1st, 2008	2008-4
Alaska	July 1st, 2008	2008-3	July 7th ,2009	2009-3

3.3.3 Distinction between One-Free and Non-Free bag fees policy

All airlines that have implemented fees did so in phases, i.e., carriers first allowed one free checked-in bag and imposed fees on the second checked-in bag, and later imposed fees on all checked-in bags. In order to distinguish between the effects of these two sequential moves, the *Bags_Fee* variable in all three equations is replaced with two new variables separating the fees implementation into two: *One_Free* and *Non_Free* bags. *One_Free* is the situation wherein the airlines allowed one free checked-in bag, and charge a fee on the second and subsequent bags. This was generally the first step for almost all carriers in the implementation of the fees policy. It is a binary variable which equals one for all quarters for an airline-route combination after the first implementation up to the quarter when no bags are checked in free. It equals zero otherwise. *Non_Free* is calculated as *Bags_Fee*-*One_Free*. It is, therefore, equal to one for all quarters after the full implementation of the fees policy up to the eleventh quarter after the fact for the average carrier, since only one quarter separated the two fees policies in most carriers, and zero otherwise.

3.3.4 Moderating effects of route characteristics

To put the findings into context, I test series of moderating impacts on the BF-late flights linkage. As argued earlier, there are reasons to suggest that the effect of BF on late flights may differ depending on route specific characteristics such as being a leisure market, hub activities, the presence of low-cost carriers on, and the concentration of the route.

Our main objective is to gauge how the response of late flights to BF differs depending on these four route characteristics. I am therefore interested only in how the net effect of BF is moderated by these factors. Consequently, I use reduced form models of late flights rather than the full structured three equation models. That is, for simplicity, the existence of different fares for BF and non-BF carriers, and the negative effect on passengers, are suppressed in these models, having fully discussed them in the full models. The results are, however, unaffected as the sum of the effects from the full model exactly matches the result from these reduced form models.

3.3.4.1 Moderating effects of hub-routes

A large proportion of the travelers through hub-ports originates from other ports. For these travelers, there is no security check which may reduce the possibility of security related delays. Second, the reduced number of bags as a result of the fees would mean fewer bags to be sorted, loaded, or transferred to other aircrafts. All these would decrease late flights. On the other hand, there are many flights connecting at hub ports which may impact late flights negatively. First, any delay in a preceding flight may impact the departure of succeeding flights. Second, hub ports may be more congested in terms of passengers, aircraft take-offs, and landings which may cause substantial delays after a fees policy.

To differentiate the net effects of imposing a fee on hub-routes, (i.e., routes with at least the origin or destination[21] serving as a hub airport for carrier *i*), from non-hub routes on late flights, the variable, *Hub*, is added as shown in Equation 4. This variable is equal to one for all carrier-route combinations with at least one of the origin or the destination ports

[21] In this research, I use the terms "origin" and "destination" or "O-D pair" to imply departure and arrival airports respectively in the BTS segments databases.

classified as a hub airport (Steven, et al., 2016). The interaction of this variable with *Bags_Fee* variable is used to estimate differential effects of charging baggage fees on these hub-airport routes.

$$Late\_Flights_{ijt} = \gamma_0 + \gamma_1\ Bags\_Fee_{ijt} + \gamma_2 Hub_{ijt} + \gamma_3 Bags\_Fee_{ijt} \times Hub_{ijt} + \gamma_4 Merger_{ijt} + \gamma_5 Recession\_Control_t + \gamma_6 Block\_Difference_{ijt} + \gamma_7 LowCost_{ijt} + \gamma_8 Distance_j + \sum_{x=9}^{19} \gamma_x carrier + \sum_{y=20}^{30} \gamma_y year + \sum_{31}^{33} \gamma_z quarter + \varepsilon_{ijt} \dots\dots\dots\dots (4)$$

3.3.4.2 Moderating effects of leisure market

Since more leisure travelers (who tends to carry more bags) fly on leisure routes than business travelers (who prefer to travel light), it is possible that the effect of BF on late flight on such routes could be higher in relation to other routes.

To measure how a leisure market would change the net effects of BF policy on late flights, I create a leisure variable, *Leisure_Route*, and add it to the reduced form model as shown in Equation 5. This is a continuous variable which is calculated as the absolute difference between an origin's and destination's average January high temperatures. A high value of this variable is likely to indicate a leisure market, where vacation passengers travel from cold to warmer climates (Brueckner, et al., 2015). The interaction of the *Leisure_Route* and the *Bags_Fee* variable terms shows the difference in the effects of BF on late-flights on the two categories of routes.

$$Late\_Flights_{ijt} = \gamma_0 + \gamma_1\ Bags\_Fee_{ijt} + \gamma_2 Leisure\_Route_{jt} + \gamma_3 Bags\_Fee_{ijt} \times Leisure\_Route_{jt} + \gamma_4 Merger_{ijt} + \gamma_5 Recession\_Control_t + \gamma_6 Block\_Difference_{ijt} + \gamma_7 Hub_{ijt} + \gamma_8 LowCost_{ijt} + \gamma_9 Distance_j + \sum_{x=10}^{20} \gamma_x carrier + \sum_{y=21}^{31} \gamma_y year + \sum_{32}^{34} \gamma_z quarter + \varepsilon_{ijt} \ldots\ldots\ldots\ldots (5)$$

3.3.4.3 Moderating effects of presence of a low-cost carrier on a route

To investigate how the presence of low-cost carriers on a route affects the BF-late flights linkage, I define a dummy variable, *LowCost* at route level, which takes on value one if any of the low-cost carriers (i.e Southwest, AirTran, Frontier, and JetBlue) operates on route *j*, zero otherwise. This variable is interacted with the *Bags_Fee* variable as well, in the estimation of late flights, as shown in Equation 6.

$$Late\_Flights_{ijt} = \gamma_0 + \gamma_1\ Bags\_Fee_{ijt} + \gamma_2 LowCost_{ijt} + \gamma_3 Bags\_Fee_{ijt} \times LowCost_{ijt} + \gamma_4 Merger_{ijt} + \gamma_5 Recession\_Control_t + \gamma_6 Block\_Difference_{ijt} + \gamma_7 Hub_{ijt} + \gamma_8 Distance_j + \sum_{x=9}^{19} \gamma_x carrier + \sum_{y=20}^{30} \gamma_y year + \sum_{31}^{33} \gamma_z quarter + \varepsilon_{ijt} \dots\dots\dots\dots (6)$$

3.3.4.4 Moderating effects of route concentration

To investigate how the route concentration may affect the fees-late flights linkage, I interact the market concentration variable, *HHI*, with the *Bags_Fee*, and include the interaction variable in the estimation of the *Late_Flights* ratio as a result of fees implementation. This is demonstrated in Equation 7.

$$Late\_Flights_{ijt} = \gamma_0 + \gamma_1\ Bags\_Fee_{ijt} + \gamma_2 HHI_{jt} + \gamma_3 Bags\_Fee_{ijt} \times HHI_{jt} + \gamma_4 Merger_{ijt} + \gamma_5 Recession\_Control_t + \gamma_6 Block\_Difference_{ijt} + \gamma_7 Hub_{ijt} + \gamma_8 LowCost_{ijt} + \gamma_9 Distance_j + \sum_{x=10}^{20} \gamma_x carrier + \sum_{y=21}^{31} \gamma_y year + \sum_{32}^{34} \gamma_z quarter + \varepsilon_{ijt} \dots\dots\dots\dots (7)$$

3.3.4.5 Temporal effects

The effects of fees policies, especially on air travel demand may diminish over time. First, travelers may stop reacting to the price increase as the new pricing becomes the new normal, given the fact that the increment in the overall cost of travel due to fees is minimal (Bruekner, 2013). Second, given the fact that ticket prices (base) generally decrease for airlines implementing fees, and that it increases for Southwest (Henrickson & Scott, 2012), the only non-fees carrier, alternatives in the long run may be limited. To gauge these potential intertemporal effects, the *One_Free* variable is split into four-single quarters, and the *Non_Free* into three quarters, plus all subsequent quarters combined: *Non_Freeq1*, *Non_Freeq2*, *Non_Freeq3*, and *Non_Freeq4plus.* The reason is that, for the carriers in the data set, the maximum number of quarters separating the two policies is four while on average only one quarter separates the two implementation dates.

3.3.5 Data and data sources

In order to answer the research questions, a panel dataset consisting of 46 quarters is collected from On-Time Performance Database from the Department of Transportation (DOT) Bureau of Transportation Statistics (BTS). The data set starts from third quarter of 2003[22] to fourth quarter of 2014. As shown in Table 15, most of the carriers changed their baggage fees policy in 2008. Hence, I have collected the data in a way that 2008 is somehow mid-way between the time period considered, which would

[22] The data on the causes of delays has been provided by BOT since June 2003. In order to avoid bias in the analysis, the database starts from third quarter of 2003.

provide the best possible idea about the changing trend brought about by the imposition of fees.

On-Time Performance database provides information on all flights including estimated departure time, actual departure time, estimated arrival time, and actual arrival time. It also reports delays in minutes at flight level separated into five cause categories: Carrier Delay, Weather Delay, Security delay, Late Aircraft Delay, and National Air System Delay. I used Carrier Delay, and Late Aircraft Delay from this database to build the main dependent variables, *Late_Flights*[23].

DB1B Market database provided by the Department of Transportation (DOT) Bureau of Transportation Statistics (BTS) is used to gather information about ticket fares. DB1B is a 10% sample of airline tickets from reporting carriers. I used the airport group code provided in this database to distinguish the non-stop domestic flights, since the main database (On-Time Performance Database) contains only the non-stop domestic flights. The other main variable, *Passengers*, is computed using the T100 database at BTS.

All airlines except Southwest have changed their fees policy; and at this point Southwest is the only airline which does not charge fees on checked-in baggage. Since the imposition

[23] In my preliminary study, I had included data on security delays but given that it comprises only 0.01% of the delays it did not have any significant impact on overall on-time performance.

dates of charging baggage fees for some of the airlines are not available, after gathering the dates of imposing fees from the literature and news articles, I ended up using American Airline, Alaska, JetBlue, Continental, Delta, Frontier, AirTran, American Eagle, Northwest, United Airline, US Airways and Southwest in the database. Aggregating the data from flight level to carrier-route level, removing airlines with unknown fees imposing dates, and winsorizing the data resulted in a final data set of 158,572 observations.

Table 16 gives the descriptive statistics of some variables on average, and Table 17 gives the means of main variables by individual airlines. Table 18 gives the means of late flights before, and after 2008, the year the fees policies were implemented. For almost all carriers, late flights improved after 2008.

Table 16 - Descriptive statistics of some important variables

Variable	Mean	Std. Dev.	Min	Max
Yield	0.247426	0.176705	0.07	0.75
Passengers	25747.52	19658.59	1725	93919
Late_Flights	0.18414	0.094216	0	0.96
Market_Size	2033031	2071109	2901	1.20E+07
Leisure	16.68588	12.01717	0	60
HHI	0.716634	0.276077	0.16	1
Block_Difference	5.445592	5.962198	-33.2	86.94
Distance	1012.399	694.4238	100	4963

Table 17 - Mean values by carrier

Carrier	Yield	Passengers	Late Flights	MarketSize	Distance
American	0.196	32815	0.196	2906198	1262
Alaska	0.251	22360	0.158	861099	1240
JetBlue	0.162	23617	0.216	3789562	1301
Continental	0.213	30071	0.196	1907064	1254
Delta	0.277	29219	0.161	1950801	1094
Frontier	0.150	23111	0.207	1406835	971
AirTran	0.170	20706	0.185	1214594	818
American Eagle	0.419	10506	0.216	3019973	526
Northwest	0.324	25177	0.197	1452432	893
United	0.226	29377	0.188	2206714	1290
US Airways	0.298	29728	0.178	1651936	998
Southwest	0.206	26298	0.168	1566513	882

Table 18 - Mean flight delays before and after 2008

Carriers	Yield		Passengers		Late_Flights	
	Before	After	Before	After	Before	After
American	0.179	0.214	31906	33841	0.195	0.186
Alaska	0.253	0.248	24195	21169	0.223	0.117
JetBlue	0.134	0.171	28896	22225	0.219	0.212
Continental	0.211	0.211	28548	34610	0.202	0.163
Delta	0.251	0.293	29545	29231	0.184	0.144
Frontier	0.159	0.147	26935	20981	0.176	0.219
AirTran	0.173	0.166	21810	19595	0.202	0.159
American Eagle	0.407	0.426	10983	10258	0.240	0.198
Northwest	0.323	0.298	25094	24957	0.199	0.184
United	0.215	0.233	31855	27678	0.205	0.169
US Airways	0.320	0.281	26460	32901	0.214	0.148
Southwest	0.174	0.224	25510	26741	0.154	0.177

3.4 Results

Table 19 provides the correlations between pairs of variables. The highest correlations are between the recession dummy and BF, and the slot control variable and market size. These are not surprising. Most of the BF implementations happened in 2008 which also coincided with the great recession. Slot-controlled airports are all located in large metropolitan areas, for instance Washington DC and New York. The least correlations are between the recession dummy and the port characteristics, as would be expected.

I have both price and number of passengers in my models, and I have argued that each affects late flights. There, therefore, are endogeneity concerns as both price and demand can result in movements in the other. So, you may not rule out entirely a possibility for some sort of cross-correlations in the residuals of the equations. The 3-stage-least-square (3SLS) model, a common estimation method that accounts for endogeneity, is more suited for the study given this fact, as it should result in better efficiency than a 2SLS. Further, the VIF for each of the variables is well below the recommended threshold of 10, suggesting that the variances in the models are not inflated by correlations between variable pairs.

The 3SLS regression results showing the effect of BF on yield, passengers, and on late flights are given in Tables 20-23, in a total of thirteen models. Models 1, 2 and 3 corresponding to Equations 1, 2 and 3 respectively, show the direct and indirect effect of fees on late flights. Models 4 and 5 and 6 (3SLS as well) show the effects of fees disaggregated by one-free BF, and non-free BF policies. Models 7-10 show the moderating effects of the presence of a hub/s and a low-cost carrier/s on a route, and the effect of concentration and leisure market on the fees-yield-passenger-late flights linkage. Model 11 shows, the intertemporal effects of BF implementation.

3.4.1 Direct and Indirect effects of fees policy on Late Flights

Our first objective is to show the linkages between fees implementation, ticket prices, passenger demand, and late flights. I have proposed a direct, and indirect links via ticket prices and passenger demand, relationship between BF implementation and late flights. To separate these effects, I implement a three simultaneous equations strategy.

Regression results showing the effect of BF on *Yield*, *Passengers*, and on *Late_Flights* are given in Models 1, 2 and 3 (corresponding to Equations 1, 2 and 3 respectively), in Table 20. As seen in Model 1, the coefficient of *Bags_Fee* is negative (-0.0058) and significant ($p<0.001$). This shows that airlines adjust ticket prices after implementing BF policy. *Passengers* has a positive (1.82E-06) and significant ($p<0.001$) coefficient, suggesting that exogenous increase in demand leads to an increase in ticket price. In Model 2, the *Bags_Fee* variable has a negative (-1534) and significant coefficient ($p<0.001$). This suggests that the implementation of BF led to a decrease in air travel demand of implementing airlines. The coefficient of *Yield* variable is also negative (-82771) and significant ($p<0.001$), indicating that increases in ticket prices lead to lower air travelers, also consistent with demand theory. In Model 3, the *Passengers* variable is added to the models to take out the indirect effect of BF imposition on late flights. The coefficient of the *Passengers* variable is positive (6.44E-06) and significant ($p<0.001$). This states that more passengers lead to more delays. The negative sign of the *Bags_Fee* variable in Model 2, and positive sign of *Passengers* variable in Model 3, together indicate that airlines which have changed their fees policy and imposed fees on checked-in bags, observed an improvement in their on-time performance through a loss in demand. Indirectly, therefore, BF implementation has resulted in reducing late flights. The coefficient of the *Bags_Fee* variable in Model 3 is negative (-0.0039) and significant ($p<0.001$). This shows that charging travelers for checked-in bags directly leads to less late flights.

3.4.2 Distinction between One-Free and Non-Free bag fees policy

In Models 4, 5 and 6, the *Bags_Fee* variable is split into two variables, *One_Free* and *Non_Free*, to distinguish the effects of the two phases in which the fees policy were implemented. The *Yield* equation results (Model 4) show that implementation of one-free BF policy did not have any significant effect on ticket price. However, implementation of non-free BF policy later led to a decrease in ticket prices. According to *Passenger* equation results (Model 5), *One_Free* and *Non_Free* coefficient both are negative (-1555 and -1526) and significant ($p<0.001$). This illustrates that implementation of BF policy, in both phase one and phase two, resulted in a lower number of travelers. Based on the results from Model 6 (Table 21), *Passengers*, *One_Free*, and *Non_Free* variables are positive (6.44E-06), positive (0.0142) and negative (-0.0107) respectively; and all significant ($p<0.001$). This illustrates that implementation of one-free fees policy led to fewer late flights through a decrease in passengers, but directly led to more late flights[24]. However, implementation of non-free fees policy later, led only to fewer late flights.

[24] The net effect is discussed in the discussions section.

Table 19 - Pairwise correlation between variables

	1	2	3	4	5	6	7	8	9	10	11
Bags_Fee (1)	1.00										
Yield (2)	0.01	1									
Passengers (3)	-0.01	-0.06	1								
Late_Flights (4)	-0.04	-0.02	0.01	1							
HHI (5)	-0.09	0.01	-0.12	-0.09	1						
Leisure (6)	0.05	-0.44	-0.01	-0.002	0.02	1					
Recession (7)	0.40	-0.01	-0.01	0.04	-0.03	0.01	1				
LowCost (8)	-0.10	-0.29	0.08	-0.05	-0.11	0.04	0.02	1			
Hub (9)	0.15	0.05	0.26	-0.001	-0.16	0.02	0.01	-0.48	1		
Slot_Route (10)	0.06	0.1	-0.01	0.22	-0.20	-0.01	0.00	-0.19	0.01	1	
Market_Size (11)	0.03	-0.05	0.09	0.2	-0.19	-0.02	-0.01	0.00	-0.02	0.65	1.00

Table 20 - Effects of BF imposition on Late_Flights with mediating effects of Yield and Passengers

Variable	Model 1 (Yield)	Model 2 (Passengers)	Model 3 (Late_Flights)
Bags_Fee	-0.0058***	-1534***	-0.0039***
	(0.0013)	(206)	(0.0014)
Passengers	1.82E-06***		6.44E-06***
	(1.25E-07)	-	(1.21E-07)
Yield		-82771***	
	-	(1595)	-
Merger	0.0083***	348*	0.0247***
	(0.0012)	(207)	(0.0014)
Recession	-0.0008	-910***	-0.0036
	(0.0021)	(343)	(0.0023)
Block_Difference			-0.0051***
	-	-	(4.48E-05)
HHI	0.0292***		
	(0.0012)	-	-
Slot_Route		3289***	
	-	(124)	-
Market_Size		0.0011***	
	-	(2.94E-05)	-
Hub	-0.0181***	16972***	-0.0828***
	(0.0023)	(198)	(0.0024)
LowCost	-0.1064***		-0.0592***
	(0.0014)	-	(0.0015)
Distance	-0.0002***	-17***	3.82E-05***
	(5.49E-07)	(0.27)	(5.84E-07)
Intercept	0.3351***	48328***	0.0378***
	(0.0037)	(708)	(0.0035)
Carrier, year and quarter dummy variables included			

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively.

Table 21 - Distinction between One-Free and Non-Free BF policy

Variable	Model 4 (Yield)	Model 5 (Passengers)	Model 6 (Late_Flights)
One_Free	0.0029	-1555***	0.0142***
	(0.0019)	(298)	(0.002)
Non_Free	-0.009***	-1526***	-0.0107***
	(0.0014)	(221)	(0.0015)
Passengers	1.82E-06***		6.44E-06***
	(1.26E-07)	-	(1.21E-07)
Yield		-82775***	
	-	(1595)	-
Merger	0.0086***	348*	0.0252***
	(0.0012)	(207)	(0.0014)
Recession	-0.0011	-910***	-0.0042*
	(0.0021)	(343)	(0.0023)
Block_Difference			-0.0051***
	-	-	(4.47E-05)
HHI	0.0291***		
	(0.0012)	-	-
Slot_Route		3302***	
	-	(124)	-
Market_Size		0.0011***	
	-	(2.94E-05)	-
Hub	-0.0181***	16972***	-0.0828***
	(0.0023)	(198)	(0.0024)
LowCost	-0.1064***		-0.0592***
	(0.0014)	-	(0.0015)
Distance	-0.0002***	-17***	3.82E-05***
	(5.49E-07)	(0.27)	(5.84E-07)
Intercept	0.3356***	48323***	0.039***
	(0.0037)	(708)	(0.0035)
Carrier, year and quarter dummy variables included			

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively.

3.4.3 Moderating effects of route concentration, leisure market, hub-route, and low-cost carrier route

To limit artificial collinearity among the variables, the interaction variables are estimated independently. The addition of multiple interactions has the tendency to inflate inter-variable correlations. Table 22 provides the regression results showing the moderating effects of hub activities on a route (Model 8), *Leisure* market (Model 9), the presence of low cost carriers on a route (Model 10), and route concentration (Model 11) on the reduced form of BF-late flights relationship.

The coefficient for the interaction term between *Hub*[25] and *Bags_Fee* variables in Model 8 is positive (0.0067) and significant ($p<0.001$), suggesting that the improvement in late flights is lower on hub-routes. The interaction term between *Bags_Fee*-and *Leisure_Route* in Model 9 has a positive (1.69E-04) and significant ($p<0.001$). The negative sign of *Bags_Fee* and positive sign of the *Bags_Fee*-*Leisure* interaction term mean that the improvement in late flights, because of charging BF, is lower on leisure routes. The coefficients of *LowCost*-*Bags_Fee* interaction and *HHI*-*Bags_Fee* interaction in Models 10 and 11 are insignificant, suggesting that the net effect of BF policy on *Late_Flights* does not in any significant way depend on the presence of a low-cost carrier on a route, nor does it depend on route concentration.

[25] The results here are almost identical to when the alternative measure of hub is used. That is, when I consider only the origin/departure airport hub status.

Table 22 - Moderating effects of route characteristics on Late_Flights

Variable	Model 7 (Basic Model)	Model 8 (Hub)	Model 9 (Leisure)	Model 10 (LowCost)	Model 11 (HHI)
Bags_Fee	-0.0097*** (0.0009)	-0.0139*** (0.0012)	-0.0126*** (0.0012)	-0.0097*** (0.001)	-0.0097*** (0.001)
Hub	0.0197***(0.0009)	0.0177***(0.009)	0.0192***(0.0009)	0.0197***(0.0009)	0.0182***(0.0009)
Bags_Fee * Hub	-	0.0067***(0.0011)	-	-	-
Leisure_Route	-	-	-0.0002*** (2.19E-05)	-	-
Bags_Fee * Leisure Route	-	-	1.69E-04*** (4.28E-05)	-	-
LowCost	-0.0022*** (0.0007)	-0.0023*** (0.0007)	-0.0019*** (0.0007)	-0.0022*** (0.0008)	-0.0121*** (0.0008)
Bags_Fee * LowCost	-	-	-	-4.55E-05 (0.0012)	-
HHI	-	-	-	-	-0.0342***(0.0009)
Bags_Fee * HHI	-	-	-	-	0.0004 (0.0011)
Merger	0.0223***(0.0009)	0.0227***(0.0009)	0.0226***(0.0009)	0.0225***(0.0009)	0.023***(0.0009)
Recession	-0.0079*** (0.0015)	-0.008*** (0.0015)	-0.008*** (0.0015)	-0.0079*** (0.0015)	-0.008*** (0.0015)
Block Difference	-0.0049*** (4.22E-05)	-0.0049*** (4.23E-05)	0.0049*** (4.22E-05)	-0.0049*** (4.22E-05)	-0.0049*** (4.21E-05)
Distance	2.14E-05*** 3.51E-07)	2.15E-05*** (3.51E-07)	2.24E-05*** (3.69E-07)	2.14E-05*** (3.51E-07)	2.28E-05*** (3.52E-07)
Intercept	0.1639*** (0.0016)	0.1654*** (0.0016)	-0.167*** (0.0016)	0.1639*** (0.0016)	0.1894*** (0.0018)

Carrier, Year and quarter dummy variables included

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively.

3.4.4 Inter-temporal Effects

The results of Model 11 in Table 23 explain how the effects of imposition of fees on late flights has changed over time. All variables except *One_Freeq1* and *One_Freeq3,* are negative and significant, suggesting that late flights improved following the BF policies implementation.

Table 23 - Temporal Effects

Variable	Model 11 (Late_Flights)
One_Freeq1	-0.0011 (0.0029)
One_Freeq2	-0.0214*** (0.0039)
One_Freeq3	-0.0066 (0.0047)
Non_Freeq1	-0.0306*** (0.003)
Non_Freeq2	-0.0342*** (0.0031)
Non_Freeq3	-0.0401*** (0.0032)
Non_Freeq4plus	-0.0446*** (0.0016)
Passengers	6.39E-06*** (1.21E-07)
Merger	0.0175*** (0.0014)
Recession	-0.0056** (0.0025)
Block_Difference	-0.005*** (4.44E-05)
Hub	-0.0807*** (0.0024)
LowCost	-0.0582*** (0.0015)
Distance	3.79E-05*** (5.82E-07)
Intercept	0.0391*** (0.0035)
Carrier, year and quarter dummy variables included	

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively

3.4.5 Control Variables

For the control variables, the *Recession* dummy has insignificant coefficients in all *Yield* equations. In all *Passengers* models it has negative and significant coefficient (i.e during 2008 recession, there was a drop in passenger demand). *Block_Difference* has a negative and significant coefficient in *Late_Flights* equation (i.e the more *Block_Difference*, the more flexible, the less delay). The coefficient of *HHI* in all *Yield* models is positive and significant (i.e. lack of competition leads in higher ticket prices). The coefficient of *Slot_Route* is positive and significant in *Passengers* models (i.e. routes with landing limitation have fewer flights, and excess demand to those flights). *Hub* in *Yield* models is negative and significant consistent with the economic logic that increased supply supresses price. In the *Passengers* models it is positive and significant as expected. In the *Late_Flights* models, *Hub* is negative and significant. In total, though, late flights are higher on hub routes through the higher number of passengers on hub routes. *Distance* coefficient is negative and positive in *Passengers* and *Late_Flights* models respectively (i.e. the longer travel the more late flights)

3.5 Discussions, Implications, and Conclusions

3.5.1 Discussions

The major finding of this research is that BF leads to improvements in airline on-time performance as measured through late flights. From the results in Models 1 and 2, for a typical airline that implemented fees policy, there was a drop of about four percent in passenger demand on a typical route per quarter. From the results presented in Model 3, the percentage of late flights decreases after fees, and the resulting loss of demand further decreases the percentage of late flights. Fees, therefore, lead to decreases in percentage of late flights on affected routes by an average of almost six percent. These marginal analyses are presented in Table 24.

Table 24 - The net effects of BF policy on Late_Flights (Models 1, 2 and 3 are used)

		Yield (Base)	BF (Contribution to Yield)	Passengers	Late_Flights
Direct Effect		-		-	-0.0039
Indirect Effect	Through Passengers only	-		-1534	-0.0099
	Through Yield and Passengers	-0.0058		480	0.0031
Total Effect		-0.0058	0.025	-1054	-0.0107
Net effect		0.019		-1054	-0.0107
Percentage change+		7.7%		-4.1%	-5.8%

+ Compared to the averages reported in Table 16

The results in Models 4, 5, and 6 reveals interesting findings on the BF-late flights relationship as well. When fees variable is broken down into two each representing one of the phases of implementation, (i.e., when the first bag can be checked-in free and charges levied on the second and subsequent bags, and when charges are levied on all bags), the results become complex, rather than a unilateral decrease in passenger demand or late flights frequency. First, from Model 4, airlines reduced their base fares only after the full implementation of BF. A possible explanation for this is with one free bag policy, passengers still have the choice of not paying BF. Therefore, BF is a payment for an add-on service. That is, a second and subsequent bags are seen as an additional service beyond the first free bag accorded traveling passengers. Examination of Model 6 suggests that late flights deteriorated after the implementation of the first fee policy but improved after the full implementation of fees. This is unexpected but logical. The initial fees may have resulted in more carry-on bags that would have resulted in security and/or boarding delays. At the same time the reduction in checked-in bags was minimal enough not to improve airport side sorting and loading activities. The total effect is an initial deterioration in flight delays. But as the full fees policy was implemented, the reduction in checked-in bags may have been large enough to lead to improvements in airport-side operations resulting in a net improvement in late flights frequency.

A third major finding of the study is contextualizing the linkage between fees and late flights. As shown in Table 25, if any or both of the O-D airports is/are designated hub port/s, the improvement in late flights following fees implementation is lower. This is a curious finding. There are two logical explanations for this finding. The first reason for this finding could lie in the complexity of operations at hub airports. The processes of bag screening, matching, and loading are more complicated at hub airports because of the several connecting flights. This complexity, and the volume of bags handled at these ports, make it harder to realize the benefits, in terms of on-time performance, of BF. The second explanation could be the volume of passengers transiting through hub ports. The implication of this finding is that complexity of hub operations diminishes the effects of unbundling airfares. Improving the complexities at these airports will engender the potential positive effects of such unbundling strategies.

I also found that the effects of fees depend on the route classification as leisure or business. The reduction in late flights are, on average, lower on leisure routes. This is a surprising result. One would think that business travelers often travel lighter with no checked bags, often do not bear the travel costs personally, and often benefit from frequent flyer programs that provide bags fly free policies. Consequently, they may be impacted less by any changes in bag fees, and respond less to such fees. The findings, however, suggest that on-time performance on leisure routes are less sensitive to BF. A logical explanation could be the fact that even though leisure travellers are more sensitive to price changes (Brons et al., 2002), once they decide to travel, they are more inclined to travel with bags. Indeed, Scotti and Dresner (2015) found that passengers are more sensitive to a base fare increase than ancillary fees. Therefore, travelers on leisure routes first may not be responding to BF, and second, once they choose to fly, they are more inclined to check in bags. These reduce the effect of BF on on-time performance. This is a significant managerial finding. This suggests that on leisure routes, the imposition of ancillary fees may not necessarily affect operational performance such as on-time performance. Further, it suggests that carriers can improve their bottom lines by raising ancillary fees on these routes without a corresponding backlash in demand and or number of checked bags.

An important, implicit finding of this research is that on average, the introduction of BF results in higher revenues through higher costs of travel to consumers. I found that with one bag fly free policy, the first phase of BF implementation, airlines did not reduce their base fares. After the full implementation, the base fare generally went down (i.e., *Yield* went down by 0.006). However, the twenty-five dollars baggage fee, on average, increased the total cost of travel by 0.025 (calculated as *Yield* using the average flight distance). Therefore, I found that BF implementation may have increased travel cost by up to almost eight (7.7) percent. How did this affect travel demand? The findings indicate that there was, on an average route, up to a four percent decrease in travel demand. The overall implication is that on an average route, the introduction of BF may have contributed positively to revenues of airlines. For instance, using the values in Table 16, an airline on an average route with a distance of 1021 miles and about 25747 passengers, may have made about 6.4 million dollars in a quarter. After implementation, the number of passengers may have dropped to 24694 but the yield increased 0.266. This may have resulted in a total, for the same route, of about 6.65 million dollars in quarterly revenues, or about three percent quarterly revenue growth[26]. This is a conservative estimation of the effect of BF on revenues. This is because cost savings as well as increased demand from improved on-time performances would lead to more future revenues (Steven et al., 2012).

Table 25 - Marginal effect of baggage fees implementation on late flights

Baggage Fees	Typical Route	Leisure	Hub
0	0.159	0.160	0.178
1	0.149	0.150	0.171
Percentage change	-6.11%	-6.13%	-4.04%

3.5.2 Conclusions and limitations

The implementation of ancillary fees such as baggage fees in the airline industry affect late flights (and in turns service quality) in different ways. Indirectly through changes in passenger demand, baggage fees implementation would lead to an improvement in delivery quality. Directly, it could improve through improvements in airport-side operations, or worsen through congestion of security queues and overcrowding of aircraft overhead bins and walkways. The final effect is hard to predict and left to conjecture by managers and policy makers. In this essay, I examine the effect of implementing baggage fees by US carriers utilizing a flight level aggregated to route level

[26] This is assuming that, on average, at least each passenger checks in a bag.

comprehensive data. I examine eleven carriers, ten of which had implemented baggage fees.

Our results indicate that on average, fees implementation result in improved on-time performance as assessed through late flights directly, as well as indirectly via ticket prices and market demand. The results also indicate that the improvements are influenced by the presence of hub-airports on the route, and the classification of travelers as leisure or business. Temporal analysis shows that the first phase in the implementation would have resulted in more flight delays, but the full implementation actually improved, and still is improving late flights.

The finding that baggage fees improves on-time performance is a significant finding for several reasons. Baggage fees have often been referenced as a cause for the long queues at security and boarding gates. In fact, delays were singled out as one reason for the introduction of the "FAIR FEES" act. The results, however, imply that blaming airline late flights on baggage fees is at best not supported and at worst misplaced. The findings, therefore, have important public policy implication. In two ways, the study confirms baggage fees as a source of revenue beyond what has been quantified. Directly, fees increase revenues. Indirectly, it also improves profitability through improved service quality (on-time performance), and consequently customer satisfaction. In conclusion, baggage fees implementation is a "floor wax and dessert topping". It raises revenues for airlines, it reduces sorting and loading complexities for airports, and it improves on-time performance for air travelers. This is also because of the fact that the improved on-time performance will affect future revenues positively (Steven et al., 2012).

There are a few limitations of the study. First, it is a fact that dissatisfaction with security queues and cramped out aircraft walkways and overhead bins are rife in the industry. One research implication, therefore, is to investigate other factors that may have contributed to these congestions. One possible factor to be investigated is the price of energy that has been historically low for a long period of time now, or any other factor that may have resulted in lower fares and in increases in air travel demand. Another research implication of the study is the fact that baggage fees result in decreases in demand, but increases in on-time performance. Since on-time performance has been found to increase profits (Dresner & Xu, 1995; Steven, et al., 2012), the net effect of baggage fees (which increases revenue directly, but also decreases revenues through lower demand) is not known a priori. Future research can build on the studies and investigate these linkages. Further, the lack of data deterred the nuanced investigation of the effects of BF on number of bags checked-in. Data permitting, future research can improve on the study by looking at these nuanced linkages. Finally, the institution of BF for one airline could have indirect impacts on other routes even if such a route does not have an airline with a baggage fee operating on the route. Since security lines are generally not route specific, any increase in length of a security queue at an origin airport would also increase the security queue for routes with no baggage fee also originating at the same airport. These spillover effects are not investigated in this research. Future research can look into these nuances of BF implementation.

CHAPTER 4

INCUMBENT CARRIERS' REACTIONS TO NEW ENTRY

4.1 Introduction

In this Chapter, I investigate the effects of threat of entry (hereafter TOE), and of entry (hereafter ET) of a new carrier into a route market, on the behaviors of incumbent carriers (hereafter ICs). Specifically, I look at TOE and ET as driving factors of changes in the ICs' behavior. The effect of a new carrier's TOE and ET on existing airlines' behavior has been studied extensively in the literature from a variety of aspects. Two most important aspects are airfares and air service quality. Multiple studies can be found in the literature addressing the effects of TOE and ET on these two factors.

Theoretically and even empirically, the total effect of TOE and ET on ICs is ambiguous, and the conclusions in the literature are mixed. In terms of air fare, some researchers have concluded that TOE and ET have downward pressure on airfares of incumbent carriers (e.g. Daraban and Fournier, 2008; Goolsbee and Syverson, 2008). Some other researchers (e.g. Tan, 2011; Gayle and Wu, 2013; Aydemir, 2012) have made a different conclusion that the effect of TOE or ET on an IC is not always downward pressure; instead, the effect may vary from one case to another. For instance, the effect depends on whether the incumbent is a legacy or a low-cost, or if there is an alliance partnership between the potential entrant and the IC. There is no consensus on the effect of TOE and ET on air service quality either. On one hand, both TOE and ET increase the potential of competition. Consequently, to stave off the competition, ICs may improve their service quality. Higher service quality though results in higher costs (Prince and Simon, 2014). Given that carriers also compete on airfares, this may result in changing the fare to accommodate the changes in quality. If carriers determine that the effects of price competition trump that of service quality competition, they may lower service quality to be able to compete on the price front. TOE and ET, therefore, may result in lower service quality.

There is a dearth of empirical work on the effects on air service quality. The few works that have explicitly examined the consequent changes in air service quality of TOE and ET have produced mixed results mirroring the theoretical arguments. For instance, whereas Gill and Kim (2017) found that TOE and ET of a low-cost carrier (LCC) result in improvements in air service quality as assessed through on-time performance, Prince and Simon (2014) found that incumbent carriers lower on-time performance as a result of Southwest (SW) airlines TOE and ET.

The actions and policies an incumbent carrier adopts in response to TOE/ET are mainly determined by the opportunities that the carrier has and the costs those actions will impose on the carrier. Consider an incumbent carrier that has a high pricing. Such a carrier affords to reduce its price hoping for attracting customers who are price sensitive, a strategy referred to as a “competitive effect” in Klemperer (1987) and Perloff and Salop (1985). Another example is an incumbent carrier with a superb on-time performance. A good strategy for such an incumbent carrier would be to either lower its market fare to attract more customers, or to differentiate away from the entering airline by investing more on other services and products (other than on-time performance) that the entering airline is not investing on; a strategy that would lead to attracting new loyal customers in exchange for higher market fare (Inderst, 2002). The theoretical foundation of the strategy of increasing price, in response to TOE or ET, is first provided by Rosenthal (1980) and Hollander (1987) and is referred to in the literature by “displacement effect” (as opposed to the “competitive effect” described earlier).

Given the logical linkage between air service quality and airfares through the cost of service quality, it is surprising that to the best of our knowledge, no work has looked at the concomitant behavior of ICs as they react to TOE and ET of new carriers. Though significant to our understanding of the phenomena, partial studies of the component effects on airfares, or on service quality in isolation of the other, may produce unreliable findings and managerial misdirection. This is because each strategic reaction affects the other. A price reduction would mean accommodating the lost revenue through lower service quality, and an improvement in quality would result in accommodating the additional cost in airfares. It is necessary therefore, to do a simultaneous analysis of the effects of TOE and ET on ICs pricing as well as quality behavior.

Further, the ambiguous theoretical linkage between TOE and ET and ICs behavior, coupled with the mixed empirical findings on the nexus between TOE and ET and ICs' service quality and pricing, supports further research is needed to add to our understanding of these linkages.

In addition, given the fact that incumbent firms may adopt different strategies in response to a TOE/ET, it is crucial, for better understanding of the effect of TOE/ET, that some classifications of incumbent airlines are taken into account. To the best of our knowledge, literature on this topic does not incorporate classifications of airlines based on their long-term service quality and market fare when analyzing the effect of TOE/ET on incumbent firms. The lack of such analysis may result in misleading or wrong conclusions.

The rest of this chapter is organized as follows. Section 4.2 discusses the literature on the relationship between a new carrier TOE/ET and ICs' reactions in terms of on-time performance and market fare. In Section 4.3, the main research questions that are studied in this chapter are described in detail. Furthermore, some conceptual background is provided. In Section 4.4, the model and data used in this chapter along with the sources of data are explained. In Section 4.5, the results and findings of this study are provided. Finally, in Section 4.6 I conclude this chapter by providing some discussions.

4.2 Literature review

4.2.1 TOE/ET and airlines airfare

In (Gayle and Wu, 2013), the price behavior of incumbent carriers to a potential entry has been analyzed for specific cases in which the potential entrant has a hub at the entry route endpoints, or the entrant carrier has an alliance partnership with the incumbent carrier. For the former case, if a hub exists, the incumbent lowers its fare more than if no hub exists, and for the latter case, the incumbent increases its fare rather than decreasing it.

The work of (Daraban and Fournier, 2008) adds to its preceding research works in multiple ways, the one of interest is the time structure of the effect of entry and exit of a low-cost carrier on incumbents' airfares. More specifically, how much of incumbents' airfare change occurs before actual entry, how much after, and how much time it takes for the price to stabilize. They find that even after low-cost carrier's exit, the incumbents' low prices do not increase to their original level before the entry had occurred.

Studying the effect of entry threat of AirTran Airways on US legacy carriers and Southwest Airlines, the work of (Aydemir, 2012) concludes that entrance of AirTran carrier has different effects on the ICs' fares depending whether they are legacy or Southwest; a significant drop of fare for legacy carriers in comparison to the Southwest airline. One possible explanation for different behaviors is the finding (Tan, 2011) that the low-cost entrant's fare is believed to be matched to the one of incumbent low-cost carrier which is lower than that of the legacy carrier.

The Brazilian market is considered in the work of (Huse and Oliveira, 2012) in which the price reaction of financially fragile incumbent carriers to the entry and its threat of low-cost carriers is studied and the conclusion is made that unlike in the U.S. market, no significant price reaction is observed in the Brazilian market before the entry, but similar to U.S market, a significant price correction is made by incumbents carriers after the entry.

While a lot of researchers focus on the post-entry reaction, Goolsbee and Syverson, (2008) analyze the pre-entry (entry threat) behavior of ICs. They found that the pre-entry reaction of ICs to an entry threat by Southwest depends on the competition intensity on the threatened route; if there has been competition on that route prior to Southwest entry, the drop in price by incumbents is insignificant. Another finding of their work is that incumbent carriers do not expand their capacity when threat entry occurs.

The literature on the effect of new entry or its threat on the ICs’ airfare is ad hoc in terms of modeling and conclusion;

different researchers have come up with different modelling and conclusion. Most of these researches have not considered the direct effect of service quality in studying the effect of entry or its threat on the ICs. Therefore, there is a gap in the literature that requires more research to be conducted in this area by proposing and studying a more comprehensive model that simultaneously considers the direct influence of service quality on the effect of entry or its threat on the ICs’ airfare.

4.2.2 TOE/ET and airlines service quality

In response to TOE and ET, airlines' behavior in terms of their pricing policy has been investigated more than their behavior in terms of service quality (Malighetti et al., 2013), mainly due to the fact that the service quality is not as easily observable and quantifiable as pricing policy. However, there are some good and comprehensive studies on the quality service, in most of which the measurable quantity of quality services is chosen to be on-time performance of the airlines.

The work of (Prince and Simon, 2014) is mainly focused on empirical research on the on-time performance reaction of ICs upon entry or threat of entry of Southwest Airlines. This work concludes that the on-time performance of ICs deteriorates when they are threatened by Southwest entry, or upon its entry.

In a more recent study, the authors of (Gil and Kim, 2017) conclude that the ICs’ service quality improves in reaction to a TOE or ET by a low-cost carrier. Although this result is in contrast with the ones of (Prince and Simon, 2014), the authors argue that the sources of the such differences in conclusion are as follows. First, the two databases used by the two works differ significantly. Second, the study of (Gil and Kim, 2017) considers the effect of entry of multiple low-cost carriers as opposed to only one low-cost carrier which is considered in (Prince and Simon, 2014). Third, a route in the work of (Prince and Simon, 2014) is directional whereas in the work of (Gil and Kim, 2017) it is non-directional, i.e., a route from A to B is in the same market as a route from B to A.

As pointed out earlier, there is a deficiency of studies conducted on effects of a new carrier's entry and the threat of entry on existing airlines' service quality. Furthermore, there is no consensus among researchers on what effects a new entry or its threat will have on incumbents’ service quality. Different researchers have come to different conclusions, some contradictory to others. Therefore, there is a need for more research to be done in this area to first enrich the literature on this topic, and second shed more light on the effects of entry or threat of entry on the service quality of existing airlines.

4.3 Conceptual Background and Research Questions

Conceptually, airlines may react to TOE and ET by lowering airfares to protect their market positioning. This hypothesis has been supported in some of the prior literature; that incumbent carriers lower their fares when they are faced with TOE, and ET of an LCC (Goolsbee and Syverson, 2008; Daraban and Fournier, 2008). However, carriers may decide to willingly increase their fares to compensate for the potential loss of customers due to the TOE and ET. The increase in the air fare can also be the result of firm's new investment to improve service quality or to add new features to make the airline more appealing, as a strategy to respond to TOE/ET. The effect of TOE and ET on airfares is therefore not straightforward.

Airlines may analogously also either increase service quality to stave off the impending competition due to TOE and ET of an LCC (e.g. Gil and Kim, 2017), or reduce quality to save on costs to be able to compete on prices (e.g Prince and Simon, 2014). An IC may willingly decide to cut its cost significantly to lower the ticket price to be able to compete on price. This will most likely deteriorate service quality. On the other hand, an IC may adopt an entry deterrence strategy. It may choose to improve its service quality significantly to make a barrier and prevent entrance. The effect of TOE and ET on service quality is therefore also not straightforward.

Intuitively, there is a positive relationship between service quality and prices. First, improving on-time performance needs more investment that leads to higher costs. Hiring more ground and crew members, maintaining additional airplanes, maintaining supply of mechanics, using larger airplanes, maintaining more slots, all are examples of investments (costs) airlines make to improve on-time performance, a measure of service quality (Mazzeo, 2003). Therefore, an airline, to protect its margin, may increase its market fare. Second, it is logical to suggest that customers are willing to pay a bit more in exchange for higher quality products. These suggest that changes in service quality resulting from TOE and/or ET may also indirectly affect prices.

The response of an IC to a TOE and ET of a new entrant carrier may also be determined by the options that the IC has and the costs those opportunities will impose on the carrier. For example, consider a hypothetical high fare carrier. This carrier has the opportunity to defend or even build upon its competitive position by decreasing its fare. This opportunity, however, may or may not be affordable for an incumbent carrier with an already low yield. Similarly, an IC with a poor on-time performance history can protect its market position by improving its punctuality as a strategy to alleviate the adverse effects of ICC TOE/ET. Such may not be a good strategy, however, for an incumbent carrier with an already superb on-time performance.

Taking into consideration all the possible cases and arguments mentioned above, the effects of TOE and ET on an ICs' behavior is not clear and could be different for different airlines depending on their overall policy in terms of service quality and pricing. Therefore, the following research questions are investigated:

In response to LCC TOE/ET:

i. How does an incumbent carrier react in terms of service quality?

ii. How does an incumbent carrier adjust its market fare measured through yield?

iii. How and if carriers with different current strategy react differently in terms of on-time performance and yield?

iv. Further, market concentration may exacerbate the reaction of incumbent carriers. Because of the lack of competition, incumbent carriers, on more concentrated routes, are more sensitive to threat/entry of a new airline. Therefore, how does market concentration moderate an incumbent carrier’s reaction in terms of on-time performance and yield?

4.4 Model specification, data, and data sources

Our research setting is the US domestic airline industry. Of particular interest is Southwest airline entry or possibility of entry into a route. I base our study on SW for a few reasons. First, SW is among the four largest carriers currently in the US market, and it is the largest low-cost carrier by revenue ($21.17 billion) as well as passenger-miles (130.26 billion RPMs). This ensures that our base subject is likely to compete with all major airlines on most major city-pair routes. Second, SW operates in more and diverse markets in terms of size, distance, and location, than any other LCC. This enables the generalization of our findings to other LCC TOE and ET. Third, SW is consistently among 10 top performers in operational service quality. It is easier to conjecture the effects of other LCC TOE/ET based on the fact that they compete more on prices and less on service quality. It is however, more managerially insightful to understand the responses to a competitor that competes on both prices and quality.

Figure 6 illustrates the theoretical framework of our conceptual relationships as argued earlier. As can be seen, there are three links involved in the research model. The first link, SW TOE/ET to market fare, hypothesizes a direct response of ICs to TOE and ET of SW. This relationship could be negative indicating that ICs respond to TOE and ET by lowering prices inhibit, or cope with SW entrance. It could also be positive if ICs choose to compete on other dimensions that build up costs that must be accommodated through higher prices. A second link hypothesizes a relationship between SW TOE and ET and on-time performance of ICs. This relationship similarly, could be positive if ICs compete on the quality dimension to deter or absorb the effects of SW ET, or negative if ICs compete on other dimensions that require cost cutting measures such as prices. The final link postulates a relationship between on-time performance as a measure of service quality to yield as a measure of price. This relationship is expected to be positive as customers are willing to pay more for high quality, and as ICs are expected to recoup costs expended on quality through higher prices.

Further, the effects of SW TOE and ET on ICs on-time performance and market fare are contextualized. Carriers with different long-term policy, I believe, may react to SW TOE/ET differently. As a result, in order to distinguish the effects, I categorize incumbent carriers based on their long-term service and pricing strategies (see section 4.4.1.2 for complete explanation) and add as moderators to our research model. Moreover, the effects of SW TOE and ET on on-time performance and market fare might change on different routes with different level of competition (e.g. Goolsbee and Syverson, 2008). Lack of competition gives incumbent carriers more flexibility to decrease the market fare and be confident of the unintended consequences of such changes on on-time performance, as travelers do not have many options to choose. Therefore, I propose market concentration as a moderator on SW TOE/ET-Ontime Performance-Market Fare relationship.

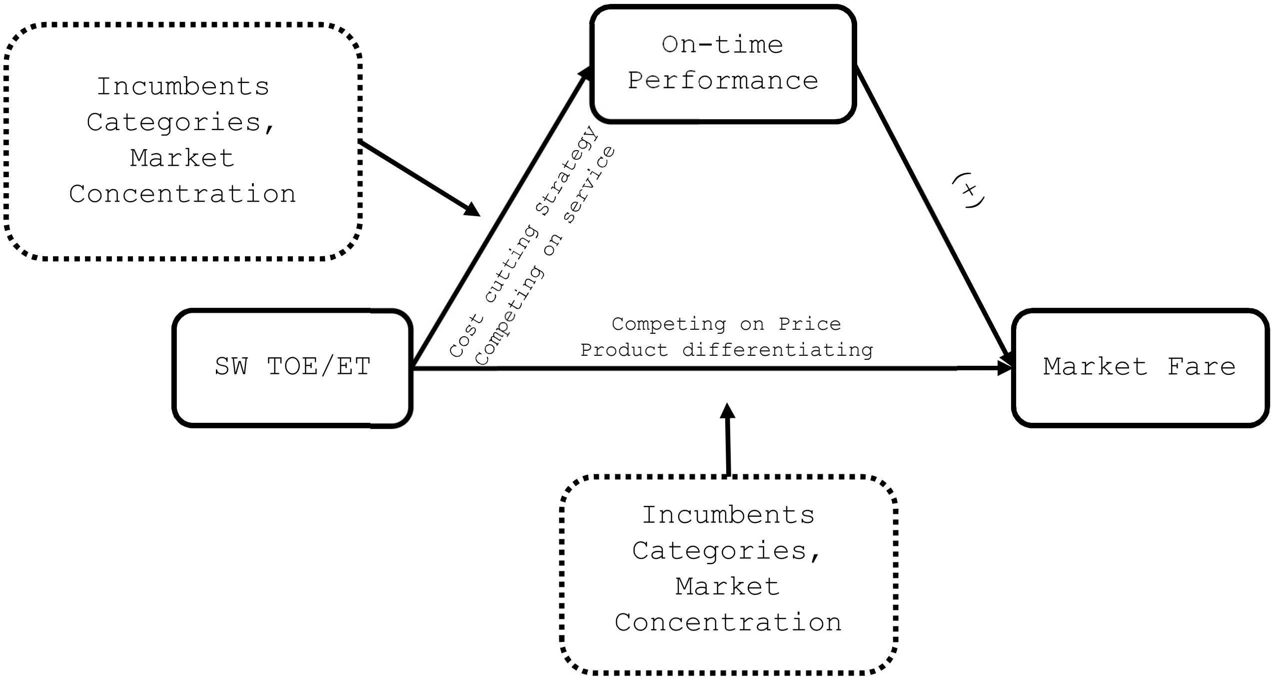

Figure 6 - SW TOE/ET- On-time Performance-Market Fare linkage, Research Model

4.4.1 Model specification and key variables

On the basis of the theoretical research model illustrated in Figure 6, I study the effects of SW TOE and ET on incumbent carriers' market fare measured through yield and service quality measured through on-time performance. Our model suggests that airlines may improve/deteriorate their on-time performance in response to SW TOE and ET and that the changes in on-time performance, consequently, affect yield. Therefore, my model proposes that on-time performance mediates the SW TOE/ET-yield relationship.

4.4.1.1 Direct and Indirect effects

The base model for this study measures the direct effect and indirect effect of SW TOE/ET on market fare. To distinguish the two effects of SW TOE/ET, I develop two statistical equation models; Equation one estimates the impact of SW TOE/ET and yield on on-time performance (Eq. (1)), and equation two estimates the impact of SW TOE/ET and on-time performance on yield (Eq. (2)), where i, j and t represent carrier, route and quarter respectively.

$$on-time\_performance_{ijt} = \alpha_0 + \alpha_1 yield_{ijt} + \alpha_2 threat_{jt} + \alpha_3 entry_{jt} + \alpha_4 LL_i + \alpha_5 LH_i + \alpha_6 HA_i + \alpha_7 on-time\_lag_{ijt} + \alpha_8 hhi_{jt} + \alpha_9 hub_{ijt} + \alpha_{10} slot\_controlled_{jt} + \sum_{y=11}^{20} \alpha_y year + \sum_{21}^{23} \alpha_z quarter + \varepsilon_{ijt} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (1)$$

$$yield_{ijt} = \beta_0 + \beta_1 on-time\_performance_{ijt} + \beta_2 threat_{jt} + \beta_3 entry_{jt} + \beta_4 LL_i + \beta_5 LH_i + \beta_6 HA_i + \beta_7 market\_size_{jt} + \beta_8 hhi_{jt} + \beta_9 hub_{ijt} + \beta_{10} slot\_controlled_j + \sum_{y=11}^{20} \beta_y year + \sum_{21}^{23} \beta_z quarter + \varepsilon_{ijt} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (2)$$

In the proposed model, *on-time_performance* and *yield* are the dependent variables. *threat*, representative of Southwest threat periods, and *entry*, representative of Southwest entry periods, are the main variables of interest. Following is the thorough definition of these variables. The detailed descriptions of all other variables are provided in Table 26 or in the related section.

4.4.1.1 Threat/Entry Variables

I follow the definition used in Goolsbee and Syverson (2008) to create the threat and entry variables. A threat is defined as the presence of Southwest on both endpoints of an Origin-Destination route, while not operating on that route. An entry happens when Southwest airline starts operation on that route. For example, assume that Southwest is already present on airport A and B, and operates on route A-B. In 2007-Q1, Southwest begins service in a new airport C, and immediately offer flights on route A-C. At this point, Southwest is present in both B and C. However, it does not operate on route B-C. In this situation, Southwest threatens entry on route B-C in 2009-Q1. In 2011-Q2, Southwest begins operations on route B-C. This is when entry happens.

4.4.1.2 Categorizing incumbent carriers

As discussed earlier in this chapter, classification of incumbent carriers is necessary and insightful when analyzing the effect of TOE/ET. Therefore, the carriers used in this study are categorized into 4 groups based on their long-term policy and performance in terms of two criteria of punctuality and pricing. The specifications used for this classification are long term (2006-2015) on-time performance, long term (2006-2015) yield, and how much carriers are concentrated around each other (Figure 7).

JetBlue (B6) and Frontier Airlines (F9) makes one group, as their yield is well lower than others, and their on-time performance are close to each other. This group is named “LC” which stands for low-cost carriers. Continental Airlines (CO), United Airlines (UA), American Airlines (AA), and Northwest Airlines constitute another group as they are clustered around each other. Their on-time performance and yield are respectively below and above the average point. This group is referred to by “LL” which stands for legacy low performer carriers. On the top right quadrant there is a group which includes US Airways (US), Delta (DL) and Alaska Airlines (AS). Both their on-time performance and yield are above the average. This group is called “LH” which stands for legacy high performer carriers. The reason that this group is separated from LL is that these airlines are clustered around each other with an on-time performance higher than the average. The Hawaiian Airlines (HA) are put in one group (referred to by “HA”) as their on-time performance is significantly higher than other airlines and the average. Such categorization does not change throughout our analysis. Figure 7 illustrates airlines with their corresponding categories.

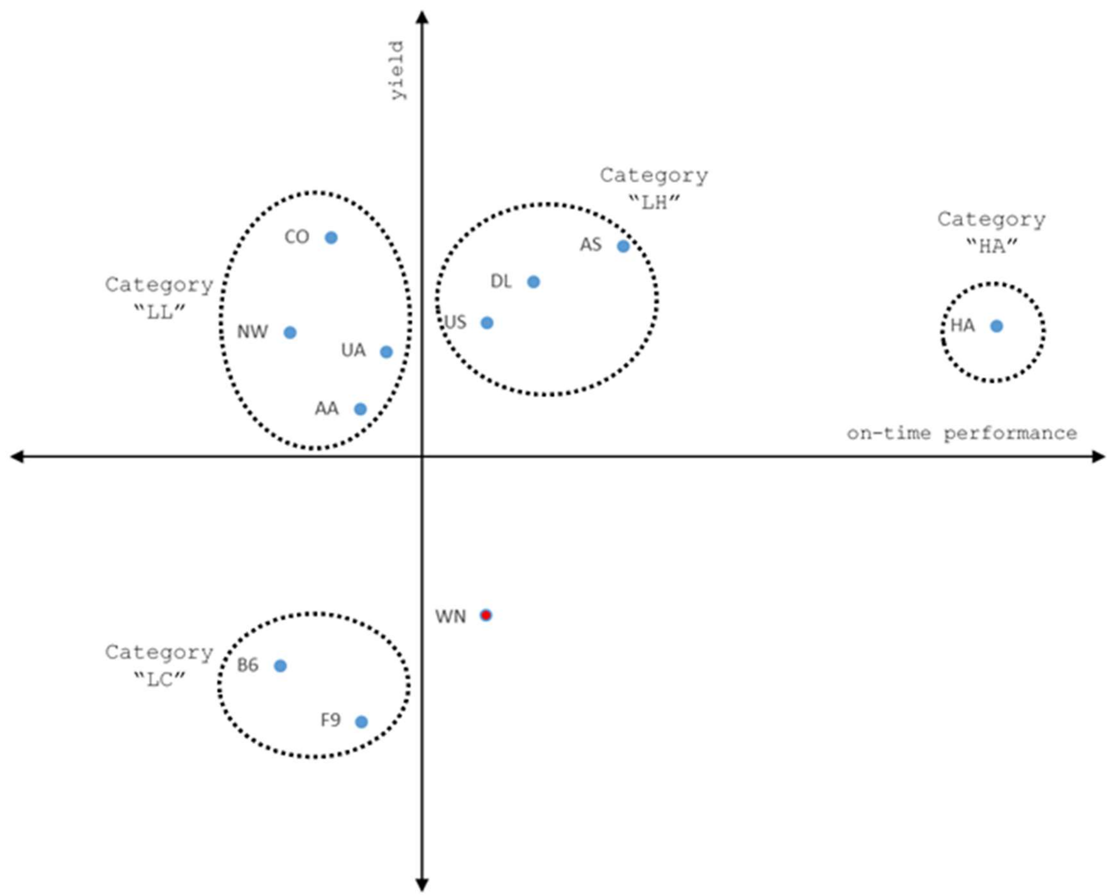

Figure 7 - Incumbent carriers categories: LC, LL, LH, HA

To distinguish if and how incumbent carriers respond to entry/threat of entry of Southwest differently, the dummy variables *LL*, *LH*, *HA*, and their interactions with *threat* and *entry* variables are constructed and included in the equations as shown in Eq. (3) and Eq. (4). Group LC is excluded from the equations, so my results are compared to LC group.

$$
\begin{aligned}
ontime\_performance_{ijt} &= \alpha_0 + \alpha_1 yield_{ijt} + \alpha_2 threat_{jt} + \alpha_3 entry_{jt} + \alpha_4 LL_i + \alpha_5 LL \times threat_{ijt} \\
&+ \alpha_6 LL \times entry_{ijt} + \alpha_7 LH_i + \alpha_8 LH \times threat_{ijt} + \alpha_9 LH \times entry_{ijt} + \alpha_{10} HA_i \\
&+ \alpha_{11} HA \times threat_{ijt} + \alpha_{12} HA \times entry_{ijt} + \alpha_{13} on-time\_lag_{ijt} + \alpha_{14} hhi_{jt} \\
&+ \alpha_{15} hub_{ijt} + \alpha_{16} slot\_controlled_{jt} + \sum_{y=17}^{26} \alpha_y year + \sum_{27}^{29} \alpha_z quarter \\
&+ \varepsilon_{ijt} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (3)
\end{aligned}
$$

$$
\begin{aligned}
yield_{ijt} = \beta_0 &+ \beta_1 ontime\_performance_{ijt} + \beta_2 threat_{jt} + \beta_3 entry_{jt} + \beta_4 LL_i \\
&+ \beta_5 LL \times threat_{ijt} + \beta_6 LL \times entry_{ijt} + \beta_7 LH_i + \beta_8 LH \times threat_{ijt} \\
&+ \beta_9 LH \times entry_{ijt} + \beta_{10} HA_i + \beta_{11} HA \times threat_{ijt} + \beta_{12} HA \times entry_{ijt} \\
&+ \beta_{13} market\_size_{jt} + \beta_{14} hhi_{jt} + \beta_{15} hub_{ijt} + \beta_{16} slot\_controlled_j \\
&+ \sum_{y=17}^{26} \beta_y year + \sum_{27}^{29} \beta_z quarter + \varepsilon_{ijt} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (4)
\end{aligned}
$$

Table 26 - Variable definitions and operationalization

Variable	Definition
Dependent variables	
ontime_performance	The percentage of flights arriving within 15 min of scheduled time on a route in a quarter.
Yield	I operationalized ticket fares as yield, which is calculated as the ticket price divided by miles flown.
Independent variables	
Threat	A binary variable that indicates the quarter in which Southwest begins to threaten entry. Full variable explanation is given in the text.
Entry	A binary variable that indicates the quarter in which Southwest begins operations. Full variable explanation is given in the text.
Control variables	
Hub	It is a binary variable, which takes value one if any of OD airports is a hub for carrier i.
Hhi	The Herfindahl-Hirschman Index, a measure of market concentration. This index is defined as the sum of the squared market shares of all airlines on an origin-destination route. This variable measures the level of competition faced by a carrier across its operating markets.
market_ size	The sum of the population of the metropolitan cities for the origin and destination (OD) airports. It is designed to capture the effect of market size on concentration and service quality.
slot_controlled	slot_controlled is a binary variable that indicates whether one or both OD airports are slot-controlled.

4.4.1.3 Moderating effects of route concentration

To measure how the route concentration may impact the linkages between the Southwest entry/threat of entry and the incumbent carrier’s reactions, the market concentration variable, *hhi*, along with its interaction with threat/entry variables are included in the model. This is shown in Eq. (5) and Eq. (6).

$$
\begin{aligned}
ontime\_performance_{ijt} \\
&= \alpha_0 + \alpha_1 yield_{ijt} + \alpha_2 threat_{jt} + \alpha_3 entry_{jt} + \alpha_4 LL_i + \alpha_5 LH_i + \alpha_6 HA_i \\
&+ \alpha_7 hhi_{jt} + \alpha_8 hhi \times threat_{ijt} + \alpha_9 hhi \times entry_{ijt} + \alpha_{10} on - time\_lag_{ijt} \\
&+ \alpha_{11} hub_{ijt} + \alpha_{12} slot\_controlled_{jt} + \sum_{y=13}^{22} \alpha_y year + \sum_{23}^{25} \alpha_z quarter \\
&+ \varepsilon_{ijt} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (5)
\end{aligned}
$$

$$
\begin{aligned}
yield_{ijt} = \beta_0 &+ \beta_1 ontime\_performance_{ijt} + \beta_2 threat_{jt} + \beta_3 entry_{jt} + \beta_4 LL_i + \beta_5 LH_i \\
&+ \beta_6 HA_i + \beta_7 hhi_{jt} + \beta_8 hhi \times threat_{ijt} + \beta_9 hhi \times entry_{ij} \\
&+ \beta_{10} market\_size_{jt} + \beta_{11} hub_{ijt} + \beta_{12} slot\_controlled_j + \sum_{y=13}^{22} \beta_y year \\
&+ \sum_{23}^{25} \beta_z quarter + \varepsilon_{ijt} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (6)
\end{aligned}
$$

4.4.2 Data and data sources

To answer our research questions, a panel dataset of 10 four-quarter years, from the first quarter of 2006 to the last quarter of 2015 is constructed. The ultimate dataset is the result of combining several different databases.

On-Time Performance database from the US Department of Transportation (DOT hereafter) provides information for non-stop domestic flights by major air carriers including departure and arrival delays, origin and destination airports, flight numbers, scheduled and actual departure and arrival times, cancelled or diverted flights, taxi-out and taxi-in times, air time, and distance. This is used to build the main endogenous variable, *ontime_performance*, and most of our control variables.

T100 database from DOT contains information on non-stop domestic flights including carrier, origin, destination, number of transported passengers, freight and mail, available capacity, scheduled departures, departures performed, aircraft hours, and load factor. This is used to construct the *hhi* variable to measure the concentration of any route.

DB1B ticket database, which is a 10% sample of airline tickets from reporting carriers, provides information for each domestic itinerary of Origin and Destination survey including the reporting carrier, itinerary fare, number of passengers, and miles flown. This database is used to construct the other main dependent variable, *yield*. DB1B ticket database along with On-Time Performance and T100 databases is used to create the main explanatory *entry*, and *threat* variables.

The raw data, at flight level, exceed 200 million observations in the study period. The data, however, is aggregated at carrier-route level with the unit of year-quarter resulting in 68414 unique flights operated within 200 airports over 1920 unique routes.

Table 27 provides descriptive statistics for the variables in the study. On a typical route, a carrier is on time 79% of the time. The average Yield is almost 0.42 $/mile.

Table 27 - Descriptive statistics of some important variables

Variable	Mean	Std. Dev.	Min	Max
ontime_performance	0.79	0.12	0.06	1
Yield	0.42	0.43	0.05	3.97
market_size	2663121	3105806	9756	1.20e+07
hhi	0.75	0.27	0.16	1

4.5 Results

Table 28 reports the pairwise correlation between main variables. The highest correlation is between market_size and slot_controlled. This is not surprising as slot_controlled airports are all located in large metropolitan areas. For this study, a three-stage-lease-square model is used[27]. The 3SLS results showing the relationship between SW TOE/ET-on-time performance-yield are reported in Tables 29-32 in total of 8 models.

Table 28 - Pairwise correlation between variables

	1	2	3	4	5	6	7	8
threat (1)	1.00							
entry (2)	-0.19	1.00						
on-time_performance (3)	0.04	0.03	1.00					
yield (4)	0.02	-0.06	0.06	1.00				
market_size (5)	-0.12	0.01	-0.22	-0.14	1.00			
hhi (6)	-0.05	-0.06	0.07	0.02	-0.28	1.00		
hub (7)	0.08	0.02	-0.00	-0.24	0.06	-0.08	1.00	
slot_controlled (8)	-0.07	-0.04	-0.23	-0.04	0.84	-0.27	0.01	1.00

[27] I also estimated the equations independently using instrumental variables for robustness check. The results are qualitatively and statistically identical to our results reported here.

The regression results in Models 1 and 2, provided in Table 29, explain the direct link between control variables, on-time performance and yield, and how on-time performance and yield affect each other.

In Model 1, the coefficients of LL, LH, and HA are -0.031, -0.025, and 0.042 respectively; this indicates that, isolating the indirect effect of yield on on-time performance, HA carriers are the best on-time performer, LC carriers are the second, then LH carriers and at the end LL carriers. The coefficient of *yield*, in Model 1, is positive (0.073) and significant ($p<0.01$) suggesting that there is a positive relationship between yield and on-time performance. This is in line with the finding in Yazdi et al., (2017); that is an increase in yield leads to a decrease in number of passengers which consequently leads to a drop in late flights. o*n-time_lag* coefficient, which is the instrumental variable, is positive (0.564) and significant ($p<0.05$) as expected. *hhi* has a negative (-0.003) and significant coefficient, confirming the negative relationship between market concentration and on-time performance (Steven et al, 2016). The coefficient of *hub* is positive (0.027) and significant ($p<0.01$) suggesting that carriers performs better on their hub. The coefficient of *slot_controlled* is negative (-0.016) and significant ($p<0.01$) implying that airlines on routes with landing limitation perform worse.

In Model 2, the coefficient of *on-time_performance* is positive (0.502) and significant (p<0.01) confirming the positive relationship between quality and yield, which means that airlines that offers high quality service charges travelers more. *LL, LH,* and *HA* variables all have positive (0.433, 0.455, and 0.189) and significant coefficients indicating that LH carriers have the highest yield; LL carriers are second, then HA carriers and LC carriers have lowest yield. Variable *market_size* has a negative (-1.71E-08) and significant (p<0.01) coefficient. *hhi* has a significant positive coefficient (0.038) confirming the relationship between *hhi* and *yield*, that is lack of competition leads to more yield (market fare). *hub* and *slot_controlled* have negative and positive coefficient respectively.

Table 29 - relationship between control variables and dependent variables

Variable	Model 1 (on-time_performance)	Model 2 (yield)
Yield	0.073*** (0.009)	-
on-time_performance	-	0.502*** (0.031)
LL	-0.031*** (0.004)	0.433*** (0.006)
LH	-0.025*** (0.005)	0.455*** (0.006)
HA	0.042*** (0.003)	0.189*** (0.010)
on-time_lag	0.564*** (0.004)	-
market_size	-	-1.71E-08*** (9.08E-10)
hhi	-0.003** (0.001)	0.038*** (0.007)
hub	0.027*** (0.004)	-0.371*** (0.004)
slot_controlled	-0.016*** (0.001)	0.077*** (0.006)
intercept	0.285*** (0.003)	-0.164*** (0.025)
year and quarter dummy variables included		

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively.

4.5.1 Direct and indirect effects

The base model is developed to show how a threat of entry/entry of Southwest affects an incumbent’s on-time performance and yield directly and indirectly. The regression results corresponding to the effects of SW TOE/ET on an incumbent’s on-time performance and yield are presented in Table 30. In Model 3, the direct effect of SW TOE/ET on on-time performance is established. The *yield* variable in Model 3 is to control for the indirect effect of SW TOE/ET on on-time performance. In model 4, *yield* is regressed on variables, *threat* and *entry* along with *on-time_performance*, which is estimated from Model 3.

In Model 3, *threat* and *entry,* the two variables of interest have negative (-0.009 and -0.004) and significant ($p<0.01$) coefficients indicating that incumbent carriers on-time performance deteriorates, on average, in response to threat and entry of Southwest Airlines. This is in line with Prince and Simon (2014) findings. All other coefficients qualitatively and statistically remain same. In model 4, *threat* and *entry* variables are added to show how incumbent carriers adjust their yield in response to TOE and ET of Southwest Airlines. The coefficient of *threat* variable is insignificant. However, *entry* variable has negative (-0.036) and significant ($p<0.001$) coefficient indicating that in reaction to ET of Southwest Airlines, incumbent carriers decrease their yield, on average.

The *yield* coefficient, in Model 3, is positive (0.084) and significant ($p<0.01$). This along with the negative coefficient of *entry* in Model 4 indicates that the yield increasing policy contributes, indirectly, to on-time performance improvement. The *on-time_perofrmance* coefficient, in Model 4, is positive (0.498) and significant ($p<0.01$). This along with the negative coefficients of *threat* and *entry* in Model 3 suggests that incumbent carriers decrease their yield even more by sacrificing the on-time performance.

Table 30 - Effects of SW TOE/ET on on-time performance and yield

Variable	Model 3 (ontime performance)	Model 4 (yield)
yield	0.084**	-
	(0.010)	
ontime_performance	-	0.498***
		(0.032)
threat	-0.009***	-8.93E-05
	(0.001)	(0.004)
entry	-0.004***	-0.036***
	(0.001)	(0.007)
LL	-0.033***	0.428***
	(0.004)	(0.006)
LH	0.028***	0.452***
	(0.005)	(0.006)
HA	0.039***	0.183***
	(0.003)	(0.010
on-time_lag	0.557***	-
	(0.005)	
market_size	-	-1.70E-08***
		(9.12E-10)
hhi	-0.004***	0.035***
	(0.001)	(0.007)
hub	0.033***	-0.369***
	(0.004)	(0.004)
slot_controlled	-0.016***	0.075***
	(0.001)	(0.006)
intercept	0.288***	-0.157***
	(0.003)	(0.026)
year and quarter dummy variables included		

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively.

4.5.2 Categorizing incumbent carriers

In Models 5 and 6, the interactions of category variables (*LL, LH, and HA*) with *threat* and *entry* variables are added to the base model to show how and if incumbent carriers react to TOE and ET of Southwest Airlines differently. The regressions results are reported in Table 31.

In Model 5: The coefficients of *threat* and *entry* which are representative of the effects of TOE and ET on LC carriers, are negative (-0.006 and -0.015) and significant ($p<0.1$ and $p<0.01$) implying that in both threat and entry periods, the service on-time performance of LC carriers deteriorates. The interaction of *LL* with *threat* is insignificant; since the threat coefficient is negative and significant, this implies that LC carriers on-time performance deteriorates once threatened by SW. The interaction of *LL* with *entry*, however, is positive (0.024) and significant ($p < 0.01$); adding this positive coefficient to the negative coefficient of *entry*, the net effect is positive implying that LL carriers, at the time of entry, improve their on-time performance. The interaction of *LH* with *threat* has a negative (-0.009) and significant ($p<0.05$) coefficient; this states that LH carriers decrease their on-time performance in reaction to SW TOE, and that the reduction is more than LC incumbent carriers'. The coefficient of LH with entry is positive (0.008) and significant ($p<0.05$); adding this to *entry* coefficient, the net effect is negative stating that LH carriers experience on-time performance decline, but less than LC carriers. The interaction of *HA* with *threat* has a negative (-0.030) and significant ($p<0.01$) coefficient stating that Hawaiian Airlines experience more performance deterioration once threatened by Southwest Airlines. Running the regression, the interaction of *HA* with *entry* omitted from the results, this is logical because SW never entered the routes in which HA group carriers operate[28].

In Model 6: The coefficient of *threat* and *entry* in the yield equation are negative (-0.107 and -0.118) and significant ($p<0.01$) indicating that LC carriers decrease their yield in reaction to SW TOE and ET. The interactions of *LL* with *threat* is positive (0.054) and significant ($p<0.01$); this along with the negative coefficient of *threat* implies that LL carriers, in reaction to SW TOE, decrease their yield less than LC carriers. On the other hand, the interaction of *LL* with *entry* variable is negative (-0.065) and significant ($p<0.01$) indicating that LL carriers decrease their yield more than LC carriers in reaction to SW ET.

Carriers in LH category act totally differently. As shown in Model 6 in Table 31, *LH* and *threat* interaction term and *LH* and *entry* interaction term both have positive (0.213 and 0.227) and significant ($p<0.01$) coefficients. Even though the threat's and entry's coefficients are negative, the net effect remains positive stating that carriers in this category increase their yield in reaction to SW TOE and ET. *HA* and *threat* interaction term has a negative (-0.285) and significant ($p<0.01$) coefficient proposing that Hawaiian Airlines decrease their yield

[28] Southwest threatened 18 unique routes during our period of study but never entered.

significantly in response to SW TOE. The interaction with *entry* is omitted from our results for the same reason explained in Model 5.

Table 31 - Effects of SW TOE/ET on on-time performance and yield based on the categories

Variable	Model 5 (ontime performance)	Model 6 (yield)
yield	0.088***	
	(0.010)	-
ontime_performance	-	0.403***
		(0.032)
Threat	-0.006*	-0.107***
	(0.003)	(0.018)
Entry	-0.015***	-0.118***
	(0.003)	(0.014)
LL	-0.041***	0.440***
	(0.005)	(0.007)
LL*threat	0.004	0.054***
	(0.004)	(0.019)
LL*entry	0.024***	-0.065***
	(0.004)	(0.018)
LH	-0.029***	0.377***
	(0.004)	(0.007)
LH*threat	-0.009**	0.213***
	(0.004)	(0.019)
LH*entry	0.008**	0.227***
	(0.004)	(0.017)
HA	0.039***	0.221***
	(0.003)	(0.011)
HA*threat	-0.030***	-0.285***
	(0.007)	(0.029)
HA*entry	Omitted	Omitted
on-time_lag	0.553***	
	(0.004)	-
market_size	-	-1.62E-08***
		(9.14E-10)
hhi	-0.005***	0.035***
	(0.001)	(0.007)
hub	0.035***	-0.379***
	(0.004)	(0.004)
slot_controlled	-0.017***	0.068***
	(0.001)	(0.006)
intercept	0.294***	-0.071***
	(0.003)	(0.027)
year and quarter dummy variables included		

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively.

4.5.3 Moderating effects of HHI

Models 7 and 8 in Table 32 present the regression results corresponding to the moderating effects of route concentration on the relationship between SW TOE/ET, on-time performance, and yield.

The interaction term of *threat* with *hhi*, in Model 7, has a positive (0.009) and significant ($p<0.01$) coefficient, indicating that an incumbent on-time performance deteriorates less on routes with less competition in reaction to SW TOE. The interaction term with *entry*, however, is insignificant. This means that the reduction in on-time performance does not depend, in any significant way, on the route competition.

The *threat* variable coefficient in Model 8 becomes positive (0.022) and significant ($p<0.05$). The coefficient of the interaction term of *hhi* with *threat* is negative (-0.030) and significant ($p<0.05$). This negative coefficient with the positive coefficient of *threat* indicates that on a competitive route, incumbent carriers surprisingly increase their yield in response to SW TOE. This is an interesting result as it implies that competition has a significant effect on the yield adjustment when SW threatens to enter. On the other hand, the coefficient of the interaction of *hhi* with *entry* is positive but insignificant. This suggests that when SW enters the market, incumbent carriers do not react differently, in any statistically significant way, on different routes with different level of competition. In all situations, they decrease their yield.

Table 32 - Moderating effects of market concentration

Variable	Model 7 (ontime performance)	Model 8 (yield)
yield	0.087*** (0.010)	-
ontime_performance	-	0.499*** (0.032)
threat	-0.016*** (0.002)	0.022** (0.010)
entry	-0.003*** (0.001)	-0.040*** (0.007)
hhi	-0.008 (0.002)	0.046*** (0.009)
hhi*threat	0.009*** (0.002)	-0.030** (0.013)
hhi*entry	-0.002 (0.003)	0.017 (0.014)
LL	-0.034*** (0.004)	0.428*** (0.006)
LH	-0.029*** (0.005)	0.452*** (0.006)
HA	0.038*** (0.003)	0.184*** (0.010)
on-time_lag	0.556*** (0.005)	-
market_size	-	-1.68E-08*** (9.16E-10)
hub	0.034*** (0.004)	-0.368*** (0.004)
slot_controlled	-0.016*** (0.001)	0.074*** (0.006)
intercept	0.290*** (0.003)	-0.166*** (0.026)
year and quarter dummy variables included		

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively.

4.6 Discussion and Conclusions

4.6.1 Discussion

There is a strong, positive and mutual relationship between on-time performance and yield. Any policy taken towards on-time performance will have an impact on airfare (yield), and any policy taken towards airfare (yield) will have an impact on on-time performance. An increase in on-time performance leads to an increase in yield and vice versa. For a typical route with the equivalent of four carriers with equal shares, serving origin-destination airports from cities with a combined population of 2637961, the relationship between on-time performance and yield in the four categories of LC, LL, LH and HA is simulated, and the results are illustrated in Table 33. According to the results, the base on-time performance of the groups, without considering the effect of yield on on-time performance, are 75.6% (LC), 72.5% (LL), 73% (LH), and 80% (HA). The results show that after Hawaiian Airlines, the low-cost carriers have the highest base on-time performance among all airlines, followed by the legacy low performer carriers and at last the legacy high performers. This is a curious observation as it seems to be contrary to the categories definition. But, once the effect of pricing policies on on-time performance, as described below, is taken into account, the on-time performance will match the categories definitions. The effect of yield on on-time performance, based on the results, is -1.5% for an LC carrier, decreasing its on-time performance from 75.6% to 74.1%; for an LL carrier, it is +1.8%, improving its on-time performance from 72.5% to 74.2%; for an LH carrier, it is +1.9%, improving the on-time performance from 73% to 74.9%; and for an HA carrier, it is -0.1% decreasing the on-time performance from 80% to 79.9%. Therefore, ranking carriers based on their performance, they match to the nature of the categories; that is HA carriers have the highest on-time performance, followed by LH carriers, then LL carriers and at the end LC carriers.

On the other hand, looking at the yield part in Table 33, the first row shows the effect of on-time performance on yield. The second row is the fee that carriers charge or discount regardless of (isolated from) the on-time performance contribution. It is -0.208 $/mi for an LC carrier; 0.242 $/mi for an LL carrier; 0.265 $/mi for an LH carrier; and -0.011 $/mi. Adding the on-time performance effect on yield to these fees, the yield is 0.172 $/mi for an LC carrier, 0.605 $/mi for an LL carrier, 0.631 $/mi for an LH carrier, and 0.390 $/mi for an HA carrier. Therefore, LH carriers have the highest yield, followed by LL carriers, then HA carriers, and at the end LC carriers, which are also consistent with the categories definition.

Table 33 – on-time performance and yield relationship (Results in Models 1 and 2 are used)

Variables		LC	LL	LH	HA
on-time performance	base performance	0.756	0.725	0.730	0.800
	pricing policy effect	-0.015	0.018	0.019	-0.001
	Performance	0.741	0.742	0.749	0.799
Yield	on-time performance value	0.380	0.364	0.366	0.401
	yield adjustment (discount/charge)	-0.208	0.242	0.265	-0.011
	yield	0.172	0.605	0.631	0.390

The first major finding of this study is that SW TOE and ET to a new market cause a reduction in both yield and on-time performance. From the results in Models 3 and 4, for a typical airline on the affected route, there is a drop of about 1.24% in on-time performance and a drop of 1.14% in yield, in the threat period. The negative effect of TOE on yield is all attributed to the reduction in on-time performance. This finding shows that, in reaction to SW TOE, incumbent carriers follow a cost cutting strategy which appears in on-time performance deterioration.

At the time of entry, however, the reduction in on-time performance decreases to 0.92% and the reduction in yield increases to 9.05%. Out of 0.92% reduction in on-time performance, 0.42% is linked to the indirect effect of yield which is almost 46% of the net effect. Out of 9.05% of the reduction in yield, 8.59% is the direct effect which is about 95% of the net effect. This finding shows that incumbent carriers, in response to SW ET, extend their cost cutting policy to other dimensions, and only 5% of the costs are saved by sacrificing on-time performance. Table 34 presents the marginal effects of SW TOE/ET on on-time performance and yield.

Table 34 - The net effects of SW TOE/ET on on-time performance and yield (Results in Models 3 and 4 are used)

Time periods		On-time Performance	Yield
Threat	Direct effect	-0.010 (-1.24%)	0.000 (0.00%)
	Indirect effect	0.000 (0.00%)	-0.005 (-1.14%)
	Net effect	-0.010 (-1.24%)	-0.005 (-1.14%)
Entry	Direct effect	-0.004 (-0.50%)	-0.038 (-8.59%)
	Indirect effect	-0.003 (-0.42%)	-0.002 (-0.46%)
	Net effect	-0.007 (-0.92%)	-0.040 (-9.05%)

Numbers in the parentheses show the percentage increase or decrease compared to the averages reported in Table 30

The second finding of this study is that incumbent carriers react differently based on the group they belong to. As one can see from Table 35, LL carriers, in response to SW TOE and ET, decrease both their on-time performance and yield simultaneously; this finding is predictable as LC carriers are famous for their low yield, and their customers are very price sensitive. As a result, LC carriers choose a cost cutting strategy to deter the entry once threatened by SW and to compete on price when SW actually enters. They even sacrifice their on-time performance to lower the cost to be able to lower the yield even more.

Based on the results in Table 35, for LL carriers, there is a reduction in on-time performance and a reduction in yield at the time of threat. This finding shows that LL carriers, like LC carriers, adopt a deterrence strategy in reaction to SW TOE. They compete on price by decreasing the cost and keeping the yield low; 5% of this reduction is linked to on-time performance deterioration. LL carriers intensify this policy when SW enters the market; they decrease their yield three times more than the reduction at the time of SW threat. This reduction in yield leads to a reduction in on-time performance. LL carriers, however, improve their on-time performance directly to compensate for 50% of this loss coming from the pricing policy.

On the other hand, LH carriers in reaction to SW TOE and ET decrease on-time performance, yet unlike LC and LL carriers increase their yield. One logical explanation for this is that LH carriers decide to differentiate away from SW by investing on products and services other than on-time performance. The latter policy toward yield is effective in two ways. First, this differentiation policy will help the incumbent carrier to maintain existing brand-loyal customers and even attract more new customers by providing services that are appealing to the new customers and in which SW has no investment (displacement effect). Second, the potential loss (that is the result of the increase in carrier yield) in the carrier's existing customers is minimal because the yield of the firm is currently high and customers who use these carriers are less sensitive to price change (price inelastic).

The drop in the yield of HA group is noticeable. One explanation for this is that since HA carriers have significantly higher on-time performance compared to other airlines, by applying a huge drop in yield they create a massive big wall in front of SW to enter.

Table 35 - The marginal effects of SW TOE/ET on on-time performance and yield, incumbent carriers are categorized.

Time periods	Categories		On-time Performance	Yield
Threat	LC	Direct effect	-0.007	-0.111
		Indirect effect	-0.010	-0.003
		Net effect	-0.017	-0.1104
	LL	Direct effect	-0.007	-0.056
		Indirect effect	-0.005	-0.003
		Net effect	-0.012	-0.059
	LH	Direct effect	-0.016	+0.109
		Indirect effect	+0.010	-0.007
		Net effect	-0.006	+0.102
	HA	Direct effect	-0.037	-0.407
		Indirect effect	-0.037	-0.016
		Net effect	-0.074	-0.423
Entry	LC	Direct effect	-0.016	-0.122
		Indirect effect	-0.011	-0.006
		Net effect	-0.027	-0.128
	LL	Direct effect	+0.009	-0.189
		Indirect effect	-0.017	+0.004
		Net effect	-0.008	-0.185
	LH	Direct effect	-0.007	+0.113
		Indirect effect	+0.010	-0.003
		Net effect	+0.003	+0.110

The third major finding of this study is contextualizing the linkage among SW TOE and ET, on-time performance, and yield at route level. As shown in Table 36, the results show that, in the threat period, as HHI increases the reduction in on-time performance decreases and the reduction in yield increases. In the entry period, the reduction in both on-time performance and yield remains the same as HHI changes. This finding that carriers react the same at the time of entry, no matter how competitive/concentrated the market is, is of significance and has important policy implication, as it shows that Southwest Airlines entry add a significant value to the competition of the market.

On a competitive market (HHI=0.25), at the time of threat there is a drop of 1.48% in on-time performance and an increase of 1.82% in yield. However, when Southwest enters the market, yield drops by 9.87%, and on-time performance drops by 0.91%. There are two explanations for this finding: First, since Southwest Airlines is a high performer in terms of on-time performance, in order to make a barrier, incumbent carriers differentiate away from Southwest by investing on other service dimensions, which consequently leads to more cost and more yield. The story is different once Southwest Airlines enters the market. At this time, incumbent carriers choose a cost cutting strategy to compete with Southwest on price line.

In the case of HHI = 1, the results show that in both threat and entry periods on-time performance and yield both decreases. However, the reduction, at the time of entry, is more severe. A logical explanation for this is that in a very concentrated market (monopoly), the lack of competition has already created a guaranteed high yield margin for the incumbent carrier. Since Southwest Airlines is a low-cost carrier and also fits in the low yield category, the incumbent carrier decreases its yield to make the market not interesting for Southwest to enter. When Southwest enters, the incumbent carrier decreases even more to keep their customers.

Table 36 - The net effects of SW TOE/ET on on-time performance and yield (Results in Models 7 and 8 are used)

Time periods	hhi		On-time Performance	
threat	0.25	Direct effect	-0.013 (-1.65%)	+0.015 (+3.35%)
		Indirect effect	+0.001 (+0.17%)	-0.007 (-1.53%)
		Net effect	-0.012 (-1.48%)	+0.008 (+1.82%)
	0.5	Direct effect	-0.011 (-1.38%)	+0.007 (+1.55%)
		Indirect effect	+0.001 (+0.08%)	-0.006 (-1.27%)
		Net effect	-0.010 (-1.30%)	+0.001 (+0.27%)
	0.75	Direct effect	-0.009 (-1.10%)	-0.001 (-0.26%)
		Indirect effect	0.000 (-0.01%)	-0.004 (-1.01%)
		Net effect	-0.009 (-1.11%)	0.006 (-1.27%)
	1	Direct effect	-0.006 (-0.82%)	-0.009 (-2.06%)
		Indirect effect	-0.001 (-0.11%)	-0.003 (-0.76%)
		Net effect	-0.007 (-0.93%)	-0.012 (-2.82%)
entry	0.25	Direct effect	-0.003 (-0.42%)	-0.042 (-9.48%)
		Indirect effect	-0.004 (-0.49%)	-0.002 (-0.39%)
		Net effect	-0.007 (-0.91%)	-0.044 (-9.87%)
	0.5	Direct effect	-0.003 (-0.42%)	-0.042 (-9.48%)
		Indirect effect	-0.004 (-0.49%)	-0.002 (-0.39%)
		Net effect	-0.007 (-0.91%)	-0.044 (-9.87%)
	0.75	Direct effect	-0.003 (-0.42%)	-0.042 (-9.48%)
		Indirect effect	-0.004 (-0.49%)	-0.002 (-0.39%)
		Net effect	-0.007 (-0.91%)	-0.044 (-9.87%)
	1	Direct effect	-0.003 (-0.42%)	-0.042 (-9.48%)
		Indirect effect	-0.004 (-0.49%)	-0.002 (-0.39%)
		Net effect	-0.007 (-0.91%)	-0.044 (-9.87%)

Numbers in the parentheses show the percentage increase or decrease compared to the averages reported in Table 30

4.6.2 Conclusions

Incumbent carriers in reaction to threat of entry and entry adopt different strategies. Some airlines may react to TOE and ET by lowering airfares to protect their market positioning; they cut their cost significantly to lower the ticket price to be able to compete on price. This will most likely deteriorate service quality. On the other hand, some may decide to willingly increase their fares to compensate for the potential loss of customers due to the TOE and ET. Some may decide to invest on improving service quality or other service dimensions to make the airline more appealing, as a strategy to respond to TOE/ET. This leads to an increase in cost and consequently market fare. On the other hand, they may willingly reduce the quality to save on costs to be able to compete on prices. Any policy taken on affects market fare or on-time performance directly or indirectly. A price reduction would mean accommodating the lost revenue through lower service quality, and improvement in quality would result in accommodating the additional cost in airfares. Therefore, in this study, I propose a simultaneous model to examine the effects of TOE and ET on ICs pricing as well as quality behavior.

My statistical results show that, on average, there is a drop in both incumbent carriers' yield and on-time performance once Southwest threatens to enter. At the time of entry, the drop in yield is significant. Further analysis shows that legacy carriers whose on-time performance is below the average point at the time of entry, while decreasing the yield to compete with SW on price line, they improve their on-time performance to partially compensate for the negative effect of decreasing yield on on-time performance. Moreover, legacy carriers who perform well in terms of on-time performance interestingly increase their yield in both threat and entry. This result is of significance as it implies that carriers with different long-term strategies adopt different strategy in response to a new entry. It is further shown that, when Southwest enters, incumbent carriers decrease their yield regardless of the market competition. This is an interesting, yet not surprising finding. It is interesting as it shows Southwest is a unique airline which adds value to the competition of any market. It is not surprising as it is the only carrier who falls in the high on-time performance – low yield quadrant.

Chapter 5

CONCLUSIONS AND SUMMARY OF FINDINGS

This dissertation contributes to the literature of service quality, pricing, antitrust and transportation. First essay develops a theoretical model, for the first time to the best of my knowledge, to tease out the indirect (through market concentration) effects of mergers on service quality. The second essay proposes a new model to describe the relationship between baggage fees, ticket price, passenger demand and on-time performance. The third essay, for the first time to the best of my knowledge, conducts a simultaneous model to investigate the effects of a new entry/threat of entry on incumbents on-time performance and market fare.

5.1 Summary of Findings

The first essay examines how recent mergers in the US, including Delta and Northwest; United Airline and Continental; and Southwest and AirTran affect service quality. The results show that due to the increase in market concentration and complexity and difficulties in consolidating operations, service quality deteriorates in the immediate years after mergers. The results also show that the negative impact of mergers on service quality fade away as time passes.

The second essay examines the linkages between the implementation of baggage fees, which occurred in two phases, and on-time performance. My results indicate that even though on-time performance deteriorates in the first phase of policy implementation, it actually improves when the policy is fully implemented. My findings also show that the improvement is the result of both improvement in airport-side sorting and loading efficiencies, and lower air travel demand. Further analysis confirms that the improvements are influenced by the presence of hub-airports on the route, and the classification of travelers as leisure or business.

The third essay examines the effects of threat of entry and entry of Southwest on incumbent carriers on-time performance as well as yield, in the US Airline Industry. My results show that incumbent carriers, on average, decrease their yield after the entry of Southwest. Also, the on-time performance of incumbent carriers generally deteriorates in both threat and entry periods. My results also show that legacy high performer carriers increase their yield in reaction to SW TOE and ET. Moreover, my analysis shows that on the concentrated routes, the impacts of threat of entry and entry on on-time performance and yield are more severe.

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