Airline Baggage Fees and Flight Delays: A Floor Wax and Dessert Topping?

Article *in* Transportation Research Part E Logistics and Transportation Review · June 2017

DOI: 10.1016/j.tre.2017.06.002

3 authors:


Amirhossein Alamdar Yazdi
Adelphi University


Pritha Dutta
University of Massachusetts Amherst


Adams Steven
University of Maryland, College Park

Transportation Research Part E 104 (2017) 83–96

Contents lists available at ScienceDirect

Transportation Research Part E

journal homepage: www.elsevier.com/locate/tre

Airline baggage fees and flight delays: A floor wax and dessert topping?

Amirhossein A. Yazdi *, Pritha Dutta, Adams B. Steven

Isenberg School of Management, University of Massachusetts-Amherst, United States

A R T I C L E   I N F O

Article history:
Received 8 September 2016
Received in revised form 3 May 2017
Accepted 1 June 2017

A B S T R A C T

We examine the linkages between the implementation of baggage fees and late flights in the airline industry. We find 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. We further find that these relationships are contingent upon the presence of a hub airport on a route. Our findings 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. Our results suggest that these suppositions could be misplaced.

1. Introduction

This paper investigates 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.[1]

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 and Scott, 2012; Brueckner et al., 2015), and air passenger demand (Scotti and Dresner, 2015). The literature, however, does not adequately address the linkage to operational service quality such as flight delays.

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 and 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

* Corresponding author.
E-mail addresses: aalamdaryazd@som.umass.edu (A.A. Yazdi), pdutta@som.umass.edu (P. Dutta), asteven@isenberg.umass.edu (A.B. Steven).

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

http://dx.doi.org/10.1016/j.tre.2017.06.002
1366-5545/

in Fig. 1, 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.

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 and 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). Our paper builds on these seminal works by looking at nuances otherwise ignored by them.

Our paper makes several contributions: First, to the best of our knowledge this is the first paper 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, our modelling 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. Our 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, we identify moderators which can further provide managerial insights. Fourth, the magnitude of our dataset (a panel data spanning over 12 years from 2003 to 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.

The rest of the paper is organized as follows: Section 2 discusses the literature on the imposition of fees in the airline industry. The literature review is followed by a hypotheses section which discusses our conceptual research questions. Section 4 discusses the research methodologies and the data used for the analysis, while Section 5 presents our findings. In Section 6, conclusions are presented, along with research and managerial implications.

2. 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 and 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 and 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 our 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 our understanding of the effects of ancillary fees on operational performance. Our 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. Our 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, our study is the first to separate the direct effects from the indirect effects through air ticket prices and demand for air travel.

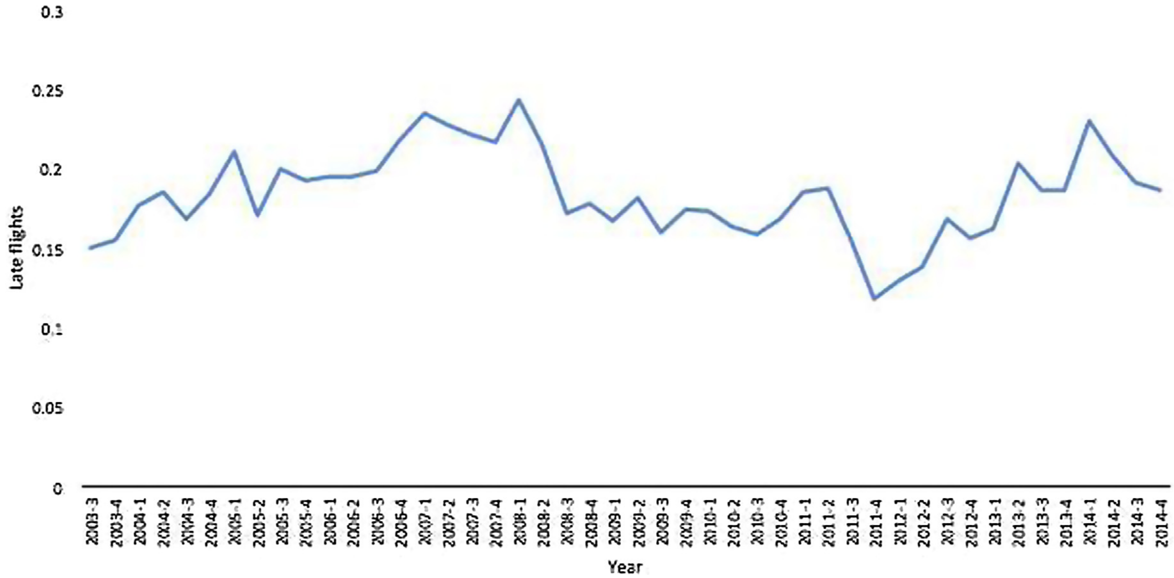

Fig. 1. Time series of late flights for an average carrier.

3. 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. Fig. 2 shows a theoretical framework for these relationships.

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[2] (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 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 and 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.

[2] 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.

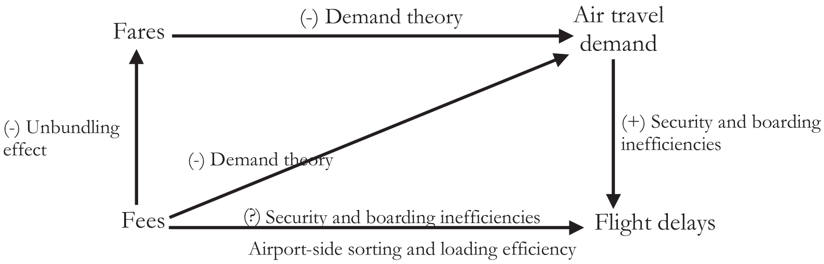

Fig. 2. Research model.

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 and Dresner (2015) found that the imposition of fees resulted in fewer airline passengers. A decrease in the number of passengers would mean a fewer 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. 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 logical arguments, the following research questions are therefore investigated:

i. 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?
ii. 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?
iii. 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?
iv. How does passenger demand affect (mediate) the relationship between fees and flight delays of carriers?
v. 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?
vi. 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, we ask: does the net effect of BF policy on flights on leisure routes differ from the effect on non-leisure route?
vii. 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?

4. Data, variables, and model specification

4.1. Model specification

On the basis of the theoretical model depicted in Fig. 2, we 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. Eq. (1) models the impact of imposing BF on yield at carrier-route level. Eq. (2) models the impact of imposing BF on passenger demand and Eq. (3) models the impact of BF policy on late flights.

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

$$Passengers_{ijt} = \beta_0 + \beta_1 Bags\_Fee_{ijt} + \beta_2 Yield_{ijt} + \beta_3 Merger_{ijt} + \beta_4 Recession\_Control_t + \beta_5 Slot\_Route_{jt} + \beta_6 Market\_Size_{jt} + \beta_7 Hub_{Ijt} + \beta_8 Distance_j + \sum_{x=9}^{19} \beta_x carrier + \sum_{y=20}^{30} \beta_y year + \sum_{31}^{33} \beta_z quarter + \varepsilon_{ijt} \quad (2)$$

$$Late\_Flights_{ijt} = \gamma_0 + \gamma_1 Bags\_Fee_{ijt} + \gamma_2 Passengers_{ijt} + \gamma_3 Merger_{ijt} + \gamma_4 Recession\_Control_t + \gamma_5 Block\_Difference_{ijt} + \gamma_6 Hub_{ijt} + \gamma_7 LowCost_{jt} + \gamma_8 Distance_j + \sum_{x=9}^{19} \gamma_x carrier + \sum_{y=20}^{30} \gamma_y year + \sum_{31}^{33} \gamma_z quarter + \varepsilon_{ijt} \quad (3)$$

where i, j and t represent carrier, route and quarter respectively.

4.1.1. Variable definitions

Table 1 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[3] among airlines in our 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 none-free bags policy. Table 2 provides the dates for all airlines we use in our database.

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[4] quarters after imposition of any fees, otherwise 0.[5] 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.

4.1.2. Distinction between One-Free and None-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 *None_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. *None_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.

4.1.3. Moderating effects of route characteristics

To put our findings into context, we 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. We are therefore interested only in how the net effect of BF is moderated by these factors. Consequently, we 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

[3] 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 our analysis.

[4] Goolsbee and Syverson (2008) also considered twelve quarters as their study period.

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

Table 1
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	We operationalised 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[a]	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[b]	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 (computer reservations system) 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

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

Table 2
Fee policy imposition dates.

Airline	One Free fee policy imposition date	One Free First Post-Fee quarter	None Free fee policy imposition date	None Free First 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

discussed them in the full models. Our results are, however, unaffected as the sum of the effects from the full model exactly matches the result from these reduced form models.

4.1.3.1. Moderating effects of hub-routes. A large proportion of the travelers through hub-ports originate 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 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 fees policy.

To differentiate the net effects of imposing a fee on hub-routes, (i.e., routes with at least the origin or destination[6] serving as a hub airport for carrier *i*), from non-hub routes on late flights, the variable, *Hub*, is added as shown in Eq. (4). 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

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

(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.

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

4.1.3.2. 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, we create a leisure variable, *Leisure_Route*, and add it to our reduced form model as shown in Eq. (5). This is a continuous variable which is calculated as the absolute difference between 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.

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

4.1.3.3. Moderating effects of presence of a low-cost carrier on a route. To investigate how the presence of low-cost carriers on a route affect the BF-late flights linkage, we 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 Eq. (6).

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

4.1.3.4. Moderating effects of route concentration. To investigate how the route concentration may affect the fees-late flights linkage, we 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 Eq. (7).

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

4.1.4. 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 (Brueckner et al., 2015). Second, given the fact that ticket prices (base) generally decrease for airlines implementing fees, and that it increases for Southwest (Henrickson and 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 *None_Free* into three quarters, plus all subsequent quarters combined: *None_Freeq1*, *None_Freeq2*, *None_Freeq3*, and *None_Freeq4plus*. The reason is that, for the carriers in our data set, the maximum number of quarters separating the two policies is four while on average only one quarter separates the two implementation dates.

4.2. Data and data sources

In order to answer our 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[7] to fourth quarter of 2014. As shown in Table 2, most of the carriers changed their baggage fees policy in 2008. Hence, we have collected the data in a way that 2008 is somehow mid-way between the time period considered, which would provide the best possible idea about the changing trend brought about by the imposition of fees.

On-Time Performance database provides information on all non-stop domestic flights by major air carriers 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. To build our main dependent variable, *Late_Flights,* we used data on delays that are carrier caused: Carrier Delay, and Late Aircraft Delay from this database.[8]

DB1B Market database provided by 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. We used the airport group code provided in this database to distinguish the non-stop domestic flights, since our 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 dates of charging baggage fees for some of the airlines are not available, after gathering the dates of imposing fees from literature and news articles, we ended up using American Airline, Alaska, JetBlue, Continental, Delta, Frontier, AirTran, American Eagle, Northwest, United Airline, US Airways and Southwest in our 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 3 gives the descriptive statistics of some variables on average, and Table 4 gives the means of main variables by individual airlines. Table 5 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.

5. Results

Table 6 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.[9] 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.

We have both price and number of passengers in our models, and we 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, we 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 our study given this fact, as it should result in better efficiency than a 2SLS.[10] Further, the VIF for each of the variables is well below the recommended threshold of 10, suggesting that the variances in our 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 7–10, in a total of thirteen models. Models 1, 2 and 3 corresponding to Eqs. (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 none-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.

5.1. 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. We have proposed a direct, and indirect links via ticket prices and passenger demand, relationship between BF implementation and late flights. To separate these effects, we implement a three simultaneous equations strategy.

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

[8] As a robustness check, we included security delays which may be outside carrier management control. Given that it comprises only 0.01% of total delays, it did not have any significant impact on overall on-time performance.

[9] We thank an anonymous reviewer for suggesting that we control for the effects of the 2008 recession.

[10] We also estimated our equations independently using instrumental variables to test the validity of our findings. The results (not reported here) are qualitatively and statistically identical to our base results reported here.

Table 3
Descriptive statistics.

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
Distance	1012.399	694.4238	100	4963

Table 4
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 5
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

Table 6
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	1.00						
Leisure (6)	0.05	−0.44	−0.01	−0.002	0.02	1.00					
Recession (7)	0.40	−0.01	−0.01	0.04	−0.03	0.01	1.00				
LowCost (8)	−0.10	−0.29	0.08	−0.05	−0.11	0.04	0.02	1.00			
Hub (9)	0.15	0.05	0.26	−0.001	−0.16	0.02	0.01	−0.48	1.00		
Slot_Route (10)	0.06	0.1	−0.01	0.22	−0.20	−0.01	0.00	−0.19	0.01	1.00	
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 7
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*** (0.0013)	−1534*** (206)	−0.0039*** (0.0014)
Passengers	1.82E−06*** (1.25E−07)	–	6.44E−06*** (1.21E−07)
Yield	–	−82771*** (1595)	–
Merger	0.0083*** (0.0012)	348* (207)	0.0247*** (0.0014)
Recession	−0.0008 (0.0021)	−910*** (343)	−0.0036 (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*** (0.0023)	16972*** (198)	−0.0828*** (0.0024)
LowCost	−0.1064*** (0.0014)	–	−0.0592*** (0.0015)
Distance	−0.0002*** (5.49E−07)	−17*** (0.27)	3.82E−05*** (5.84E−07)
Intercept	0.3351*** (0.0037)	48328*** (708)	0.0378*** (0.0035)
Carrier, year and quarter dummy variables included			

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively.
The values in the parentheses are the variances.

Table 8
Distinction between One-Free and None-Free BF policy.

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

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively.
The values in the parentheses are the variances.

Table 9
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.
The values in the parentheses are the variances.

Table 10
Temporal effects.

Variable	Model 11 (Late_Flights)
One_Freeq1	−0.0052*** (0.0019)
One_Freeq2	−0.0289*** (0.0025)
One_Freeq3	−0.0158*** (0.003)
One_Freeq4	−0.0215*** (0.0047)
None_Freeq1	−0.0344*** (0.0019)
None_Freeq2	−0.043*** (0.002)
None_Freeq3	−0.0424*** (0.0021)
None_Freeq4plus	−0.0529*** (0.001)
Merger	0.0132*** (0.0009)
Recession	−0.0094** (0.0017)
Block_Difference	−0.0047*** (4.2E−05)
Hub	0.0214*** (0.0009)
LowCost	−0.0015*** (0.0007)
Distance	2.13E−05*** (3.48E−07)
Intercept	0.1637*** (0.0016)
Carrier, year and quarter dummy variables included	

*, **, and *** denote 10%, 5% and 1% significance levels for two-tailed tests, respectively.
The values in the parentheses are the variances.

Regression results showing the effect of BF on *Yield*, *Passengers*, and on *Late_Flights* are given in Models 1, 2 and 3 (corresponding to Eqs. (1), (2) and (3) respectively), in Table 7. 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, in line with demand theory, 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 (−82,771) 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.

5.2. Distinction between One-Free and None-Free bag fees policy

In Models 4, 5 and 6, the *Bags_Fee* variable is split into two variables, *One_Free* and *None_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 none-free BF policy later led to a decrease in ticket prices. According to *Passenger* equation results (Model 5), *One_Free* and *None_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 8), *Passengers*, *One_Free*, and *None_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.[11] However, implementation of non-free fees policy later, led only to fewer late flights.

5.3. 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 9 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*[12] 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

[11] The net effect is discussed in the discussions section.
[12] The results here are almost identical to when the alternative measure of hub is used. That is, when we consider only the origin/departure airport hub status.

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.

5.4. Inter-temporal effects

The results of Model 11 in Table 10 explain how the net effects of imposition of fees on late flights has changed over time. All fees variables are negative and significant, suggesting that late flights improved following the BF policies implementation.

5.5. 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 suppresses 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)

6. Discussions, implications, and conclusions

6.1. Discussions

The major finding of our paper 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 BF, and the resulting loss of demand further decreases the percentage of late flights. BF, 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 11.

The results in Models 4, 5, and 6 reveals interesting findings on the BF-late flights relationship as well. When BF 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 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 BF 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 our study is contextualizing the linkage between fees and late flights. As shown in Table 12, 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. 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.

We 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

Table 11
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		−0.0058		−1534	−0.0039
Indirect Effect	Through Passengers only	–		–	−0.0099
	Through Yield and Passengers	–		480	0.0031
Total Effect		−0.0058	0.025	−1054	−0.0107
Net effect			0.019	−1054	−0.0107
Percentage change[a]			7.7%	−4.1%	−5.8%

[a] Compared to the averages reported in Table 3.

Table 12
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%

such fees. Our 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 travelers 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 paper is that on average, the introduction of BF results in higher revenues through higher costs of travel to consumers. We 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, we found that BF implementation may have increased travel cost by up to almost eight (7.7) percent. How did this affect travel demand? Our 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 3, an airline on an average route with a distance of 1021 miles and about 25,747 passengers, may have made about 6.4 million dollars in a quarter. After implementation, the number of passengers may have dropped to 24,694 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.[13] 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).

6.2. 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 paper, we examined the effect of implementing baggage fees by US carriers utilizing a flight level aggregated to route level comprehensive data. We examined eleven carriers, ten of which had implemented baggage fees.

Our results indicate that on average, BF implementation result in improved on-time performance as assessed through late flights directly, as well as indirectly via ticket prices and market demand. Our 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

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

reason for the introduction of the ''FAIR FEES'' act. Our results, however, imply that blaming airline late flights on baggage fees is at best not supported and at worst misplaced. Our findings, therefore, have important public policy implication. In two ways, our 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 our 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 our 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 and 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 our 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 our 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 spill over effects are not investigated in this research. Future research can look into these nuances of BF implementation.

References

Barone, G.J., Henrickson, K.E., Voy, A., 2012. Baggage fees and airline stock performance: a case study of initial investor misperception. J. Transp. Res. Forum 51(1) (September).

Brons, M., Pels, E., Nijkamp, P., Rietveld, P., 2002. Price elasticities of demand for passenger air travel: a meta-analysis. J. Air Transp. Manage. 8 (3), 165–175.

Brueckner, J.K., Lee, D.N., Picard, P.M., Singer, E., 2015. Product unbundling in the travel industry: the economics of airline bag fees. J. Econ. Manage. Strategy 24 (3), 457–484.

Dresner, M., Xu, K., 1995. Customer service, customer satisfaction, and corporate perfo. J. Bus. Logist. 16 (1), 23.

Goolsbee, A., Syverson, C., 2008. How do incumbents respond to the threat of entry? Evidence from the major airlines. Q. J. Econ. 123 (4), 1611–1633.

Henrickson, K.E., Scott, J., 2012. Baggage fees and changes in airline ticket prices. Adv. Airl. Econ. 3, 177–192.

Herrmann, A., Xia, L., Monroe, K.B., Huber, F., 2007. The influence of price fairness on customer satisfaction: an empirical test in the context of automobile purchases. J. Prod. Brand Manage. 16 (1), 49–58.

Lyn Cox, J., 2001. Can differential prices be fair? J. Prod. Brand Manage. 10 (5), 264–275.

Maxwell, S., 2002. Rule-based price fairness and its effect on willingness to purchase. J. Econ. Psychol. 23 (2), 191–212.

Mellat-Parast, M., Golmohammadi, D., McFadden, K.L., Miller, J.W., 2015. Linking business strategy to service failures and financial performance: empirical evidence from the US domestic airline industry. J. Oper. Manage. 38, 14–24.

Nicolae, M., Arıkan, M., Deshpande, V., Ferguson, M., 2016. Do bags fly free? An empirical analysis of the operational implications of airline baggage fees. Manage. Sci. http://dx.doi.org/10.1287/mnsc.2016.2500.

Scotti, D., Dresner, M., 2015. The impact of baggage fees on passenger demand on US air routes. Transp. Policy 43, 4–10.

Scotti, D., Dresner, M., Martini, G., 2016. Baggage fees, operational performance and customer satisfaction in the US air transport industry. J. Air Transp. Manage. 55, 139–146.

Siemaszko, C., 2016. Lawmakers to Airlines: Drop Baggage Fees to Shorten TSA Lines. NBC News, 12 May.

Steven, A.B., Dong, Y., Dresner, M., 2012. Linkages between customer service, customer satisfaction and performance in the airline industry: investigation of non-linearities and moderating effects. Transp. Res. Part E: Logist. Transp. Rev. 48 (4), 743–754.

Steven, A.B., Yazdi, A.A., Dresner, M., 2016. Mergers and service quality in the airline industry: a silver lining for air travelers? Transp. Res. Part E: Logist. Transp. Rev. 89, 1–13.

Tuzovic, S., Simpson, M.C., Kuppelwieser, V.G., Finsterwalder, J., 2014. From 'free'to fee: acceptability of airline ancillary fees and the effects on customer behavior. J. Retailing Consumer Serv. 21 (2), 98–107.

Xia, L., Monroe, K.B., Cox, J.L., 2004. The price is unfair! A conceptual framework of price fairness perceptions. J. Mark. 68 (4), 1–15.