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Purchase discounts and travel premiums during holiday periods: Evidence from the airline industry*

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Abstract

Discounts during Thanksgiving and Christmas are common in a variety of retail markets. Although classical economic theory predicts that prices should increase when aggregate demand is high, one possibility is that consumers are more price elastic during seasonal demand peaks. In this article, we examine holiday pricing in the airline industry. Exploiting a unique panel of almost 22 million fares, we find that fares purchased on a holiday are 1.8% cheaper, supporting the conjecture that airlines price discriminate when the mix of purchasing passengers makes demand more elastic. These holiday booking discounts are also found to be larger in competitive markets, with the largest discounts reserved for flights within one-week of departure. In contrast to flights *purchased* on a holiday, we find that *traveling* on a holiday is more expensive. Consistent with peak-load pricing, we estimate travel premiums ranging from 41.6% to 82.0% on national holidays and from 4.6% to 35.0% on federal holidays.

JEL classification: L11, L13, L93, D40.
Keywords: advance-purchase discounts, airline pricing, peak-load pricing, price discrimination, sales.

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1 Introduction

Sales during holiday periods are common in a variety of retail markets. For example, Chevalier et al. (2003) and MacDonald (2000) document that grocery prices are lower during the Thanksgiving and Christmas holidays while Warner and Barsky (1995) find that prices for consumer appliances are lower in the period preceding Christmas.[1] Moreover, Levy et al. (2010) find that price decreases are more common than price increases during holiday periods.

Although classical economic theory predicts that prices should increase during periods of high aggregate demand (such as the period surrounding Thanksgiving and Christmas), previous studies assert that prices fall during these seasonal demand peaks because consumers are more price elastic.[2] For example, MacDonald (2000) argues that high seasonal demand reduces the cost of informative advertising, which in turn increases buyers' price sensitivity. Warner and Barsky (1995) suggest that consumers are better informed in high demand states, resulting in retailers perceiving their demand to be more elastic. Similarly, Chevalier et al. (2003) argue that consumers may search more intensively for low prices during periods of high demand because the expected returns from search are larger during these periods.[3]

In this article, we examine whether holiday discounts extend to the airline industry. We expect demand to be more elastic on federal holidays because price inelastic business travelers are unlikely to purchase outside of normal business hours.[4] As a result, federal holidays provide an opportunity for airlines to price discriminate by offering discounts to passengers who purchase on these dates.

[1]For a witty review of the economics surrounding Christmas, see Birg and Goeddeke (2016).

[2]Other explanations have also been offered. For example, Rotemberg and Saloner (1986) suggest that prices fall because firms are not able to sustain tacit collusion in high demand periods. In other words, the temptation to cheat from a collusive agreement is highest during a temporary demand spike because the gain from cheating is increasing in current demand whereas the loss from punishment is increasing in future demand. Alternatively, Lal and Matutes (1994) and Hosken and Reiffen (2004) suggest that multiproduct retailers may discount highly demanded products during peak periods to facilitate greater store traffic.

[3]This explanation is consistent with Varian (1980), who argues that sales are a form of price discrimination in which firms effectively offer lower prices to consumers with superior information or lower search costs.

[4]Escobari et al. (2019) find that airfares are higher during business hours and lower in the evening. We also expect demand to be more elastic on "shopping holidays" such as Black Friday, Christmas Eve, and New Year's Eve because many public and private sector employees request these days off from work.

Price discrimination may result in higher profits if firms are able to agree on which types of consumers are price elastic (Borenstein, 1985; Holmes, 1989). However, even if airlines agree that passengers purchasing on a federal holiday are more price elastic, they may still avoid discriminatory pricing. For example, Corts (1998) shows that price discrimination may result in "all-out competition" where prices are lower for all consumers than under uniform pricing. In this competitive environment, the ability to price discriminate results in a prisoner's dilemma in which each firm has a dominant strategy to price discriminate even though profits would be higher for all firms if discrimination were not possible.

Furthermore, recent work by Ciliberto and Williams (2014) and Ciliberto et al. (2019) suggests that airlines may be tacitly colluding when setting fares. If airlines are colluding, they may coordinate to avoid certain types of discriminatory pricing. Coordination is also expected to be easier in the consolidated U.S. airline industry where American, Delta, Southwest, and United currently control over 80% of the domestic market.[5] Therefore, although we hypothesize that federal holidays provide an opportunity to price discriminate by discounting fares, it is possible that airlines may coordinate to avoid this type of discriminatory pricing.

To determine if airlines price discriminate on federal holidays, we exploit a unique panel of almost 22 million fares collected over a seven-month period. Our fare data is comprehensive, encompassing many densely traveled routes across the continental United States (U.S.). Tracking the price of each flight in the sixty-day period prior to departure, we find that fares published on a major holiday are 1.8% cheaper on average. Allowing for heterogeneity in discounts across holidays, we find that the holiday booking discount ranges from 0.9% on Cyber Monday to 5.9% on Christmas Eve and Christmas Day. Moreover, we find that the largest holiday discounts are offered for flights that are within one-week of departure (flights typically purchased by business travelers), supporting the conjecture that airlines discount

[5]Mergers between American and TWA in 2001, US Airways and America West in 2005, Delta and Northwest in 2008, United and Continental in 2010, Southwest and AirTran in 2011, American and US Airways in 2014, and Alaska and Virgin America in 2016 have resulted in the four largest airlines (American, United, Delta, and Southwest) holding almost 85% of the U.S. market.

fares on federal holidays because price inelastic business travelers are unlikely to purchase on these dates.

Further decomposing our results, we examine how holiday booking discounts are affected by market structure. As discussed in Borenstein (1985), Holmes (1989), and Chandra and Lederman (2018), the relationship between competition and price discrimination is ambiguous in oligopolistic markets when consumers differ both in their underlying willingness-to-pay and their degree of brand loyalty. On average, we find that holiday booking discounts are largest in highly competitive markets (2.2% cheaper) and lowest in concentrated markets (1.5% cheaper).

Supplementing our analysis of holiday booking discounts, we also examine pricing for flights that depart in the days surrounding major holidays. Demand for these flights are expected to be high ex-ante. For example, Thanksgiving and Christmas are national holidays that coincide with large volumes of passengers traveling to visit family while federal holidays observed on a Monday (e.g., Martin Luther King Day, President's Day, Labor Day, and Columbus Day) coincide with large volumes of passengers traveling home after enjoying an extended weekend.[6] Consistent with the theory of peak-load pricing, we estimate travel premiums ranging from 41.6% to 82.0% on national holidays and 4.6% to 35.0% on federal holidays.

The rest of this article is organized as follows. Section 2 summarizes previous literature on price discrimination in oligopolistic markets, with a particular emphasis on empirical studies of the airline industry. Section 3 describes the fare and itinerary data collected for the empirical analysis. Section 4 presents a descriptive analysis of dynamic pricing in the sixty-day period leading up to a flight's departure. Section 5 outlines the empirical models used to identify holiday booking discounts and holiday travel premiums (i.e., holiday peak-load pricing). Section 6 presents results from our holiday booking and holiday peak-load

[6]National holidays are days most government and private sector employees receive off from work. Federal holidays are days most federal and state government employees receive off from work that private sector employees may or may not receive.

pricing analyses. Finally, Section 7 concludes.

2 Price Discrimination and Price Dispersion in Oligopolistic Markets

Price discrimination occurs when firms charge consumers different prices for an identical product. Three conditions are necessary for price discrimination to occur. Foremost, firms must have market power. Second, consumers must have different demand elasticities and firms must have the ability to distinguish between consumers with different elasticities. Third, firms must have the ability to prevent arbitrage from occurring (e.g., by preventing resale of the product). When these conditions are met, the mechanisms firms use to differentiate consumers are typically classified as second or third-degree price discrimination.[7]

Second-degree price discrimination occurs when firms offer a menu of prices that induce consumers to differentiate themselves. Non-linear pricing strategies such as quantity discounts and charging different prices for refundable and non-refundable tickets are examples of second-degree price discrimination. In contrast, third-degree price discrimination occurs when firms directly segment consumers according to some observable metric. Student discounts, senior citizen discounts, and prices that vary by location are examples of third-degree price discrimination.

Firms in a variety of industries including automobiles, Broadway theater, hospitality, and retail engage in price discrimination (Chevalier and Kashyap, 2019; Leslie, 2004; Verboven, 1996, 2002). In the airline industry, a sizable literature has developed examining the various ways in which airlines practice second and third-degree price discrimination. Dana (1998) and Gale and Holmes (1993) show that advance-purchase restrictions enable airlines to reduce fares for price-elastic leisure travelers. Other ticket restrictions such as Saturday-night stay,

[7] First-degree price discrimination occurs when each consumer is charged their exact willingness-to-pay. This form of price discrimination is rare.

length of stay, and non-refundability are designed to discourage price-inelastic passengers from buying cheaper tickets (Escobari and Jindapon, 2014; Stavins, 2001).[8] Puller and Taylor (2012) find that fares purchased on weekends are 5% cheaper, supporting the conjecture that airlines price discriminate when the mix of purchasing passengers makes demand more elastic. Applying a similar argument, Escobari et al. (2019) find that fares are higher during business hours and lower in the evening. Additionally, Luttmann (2019b) and Lewis (2020) offer conflicting evidence on the existence of directional price discrimination in the domestic U.S. market.[9]

The empirical analysis presented in this article is also motivated by the extensive theoretical literature on the relationship between competition and price dispersion when firms practice third-degree price discrimination.[10] In particular, Borenstein (1985), Holmes (1989), and Chandra and Lederman (2018) show that the relationship between competition and price discrimination in oligopolistic markets is ambiguous when consumers differ both in their underlying willingness-to-pay and their degree of brand loyalty.

Consistent with theory, previous empirical studies of the airline industry that examine this relationship provide conflicting results. Borenstein and Rose (1994) and Stavins (2001) find that competition increases price dispersion while Gaggero and Piga (2011) and Gerardi and Shapiro (2009) find that competition reduces price dispersion. Furthermore, Dai et al. (2014) find a nonmonotonic relationship, with competition increasing dispersion in concentrated markets and reducing it in competitive markets. Examining the Canadian airline industry, Chandra and Lederman (2018) find that competition has little impact at the top or bottom

[8] Escobari and Jindapon (2014) present a theoretical model examining how airlines use refundable and non-refundable tickets to screen consumers who are uncertain about their demand. Empirically, they show that the difference in fare between refundable and non-refundable tickets declines as the departure date approaches.

[9] Directional price discrimination occurs when airlines charge different prices on the same flights to passengers who originate from different endpoints. This form of price discrimination is feasible if demand elasticities substantially differ between endpoint cities. Using aggregated transacted fare data from 2015, Luttmann (2019b) finds evidence consistent with airlines practicing directional price discrimination. Using published fare data, Lewis (2020) finds that airlines do not directionally price discriminate on domestic routes but do directionally discriminate on international routes.

[10] See Stole (2007) for a comprehensive review of price discrimination under oligopoly.

of the price distribution but a significant impact in the middle of the distribution, with competition increasing some price differentials and decreasing others.

3 Fare and Itinerary Data

Previous empirical studies that examine airline price dispersion and price discrimination in the U.S. have typically relied on the U.S. Department of Transportation's Airline Origin and Destination Survey (DB1B).[11] Data from this survey are released quarterly and represent a 10% random sample of all airline tickets sold for U.S. domestic travel. However, the DB1B data do not include information on the specific flight(s) purchased or the exact purchase and departure dates (only the quarter of travel is reported). As a result, the DB1B cannot be used to examine holiday pricing or control for other factors that may affect fares, such as advance-purchase requirements or the specific date of travel. With these shortcomings in mind, we constructed our own dataset using published fare and itinerary information from a major online travel agency.[12]

In lieu of collecting published fares for all possible routes in the U.S. market, we relied on DB1B data from the third and fourth quarters of 2018 to identify the 98 major airport-pairs within the continental U.S. ranked by total passenger traffic.[13] These routes were supplemented with 17 monopoly, 24 duopoly, and 16 airport-pairs without nonstop service (these are routes where passengers must take a connecting flight to reach their destination).[14] Due to overlap between the 98 major and 24 duopoly airport-pairs, our analysis covers a total of 148 directional airport-pairs instead of 155. A detailed list of these routes is provided in Appendix Table A1.

[11]These studies include Borenstein and Rose (1994), Hayes and Ross (1998), Gerardi and Shapiro (2009), Dai et al. (2014), and Luttmann (2019b), among others.

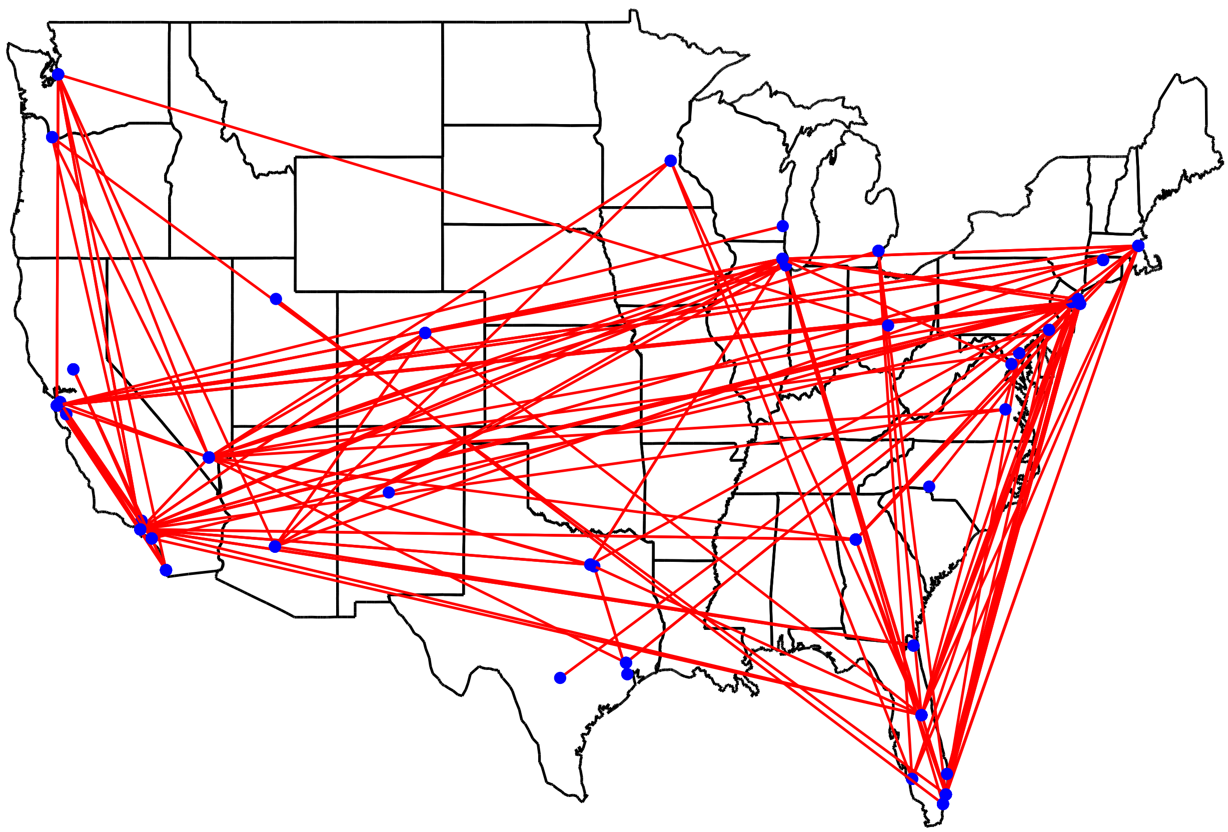
[12]Major online travel agencies (OTAs) and aggregator websites include Expedia, Google Flights, Kayak, Priceline, Skyscanner, and Travelocity. This article is not the first to analyze data from a major OTA. For example, see Escobari (2009), Escobari et al. (2019), and Luttmann (2019a), among others.

[13]A market in our analysis is defined as a directional pair of origin and destination airports. Therefore, Los Angeles (LAX)-New York (JFK) and New York (JFK)-Los Angeles (LAX) are treated as separate markets.

[14]The list of monopoly, duopoly, and connecting airport-pairs were also ranked by total passenger traffic.

Figure 1 displays a map of the routes included in our analysis. As the map illustrates, our route coverage is fairly comprehensive across the continental U.S.

Figure 1: U.S. domestic routes included in our analysis sample



To construct our analysis sample, data were collected over a seven-month period for flights departing between October 1st, 2019 and February 29th, 2020.[15] Fare quotes were obtained daily, for one-way travel between the airport-pairs listed in Appendix Table A1.[16] For each route, fares for each of the next sixty travel days were collected, allowing us to track the price of an individual flight (or sequence of flights for connecting trips) over the sixty-day

[15] Because our analysis sample ends on February 29th, 2020, the COVID-19 pandemic has a negligible impact on our results. In the U.S., COVID-19 was declared a national emergency on March 13th, 2020. Moreover, California became the first state to issue a statewide stay-at-home order on March 19th, 2020.

[16] We focus on one-way trips due to difficulties in specifying trip duration. For any given departure date, there are a substantial number of roundtrip fares that could potentially be gathered, each depending on trip duration. For example, fares for three-day trips are likely different from seven and fourteen-day trips. Similar articles using published fare and itinerary data also focus on one-way trips due to this duration issue. Examples include Bilotkach (2005), Bilotkach et al. (2010), Escobari et al. (2019), and Luttmann (2019a).

period prior to departure.[17] We focus on a sixty-day window to capture leisure travelers who purchase flights well in advance of the departure date in addition to business travelers who purchase flights closer to the date of departure.[18]

Our sampling procedure resulted in a unique sample of 21,829,963 observations. 30.8% of our observations are for connecting trips. The airlines included in our sample are Alaska, Allegiant, American, Delta, Frontier, JetBlue, Spirit, Sun Country, and United.[19]

4 Descriptive Analysis of Dynamic Pricing During the Booking Period

To illustrate how fares evolve in the sixty-day period prior to departure, Figure 2 displays the average fare per mile by number of days to departure for each of the nine airlines in our analysis sample.[20] The top panel of Figure 2 displays averages for the four largest full-service carriers (Alaska, American, Delta, and United) while the bottom panel displays averages for the five low-cost carriers (Allegiant, Frontier, JetBlue, Spirit, and Sun Country). For both full-service carriers (FSCs) and low-cost carriers (LCCs), the fare per mile remains relatively stable during the early part of the booking period, starts to increase three weeks before departure, and substantially increases in the last seven days to departure.

For FSCs, there are four well-defined fare hikes that occur from twenty-one to twenty, fourteen to thirteen, seven to six, and three to two days prior to departure. In other words, FSCs sharply increase fares at specific three-week, two-week, one-week, and three-day milestones prior to departure. The first three milestones likely reflect the expiration of discount

[17] For example, fare quotes for a flight departing on January 1st, 2020 were collected daily between November 3rd, 2019 and December 31st, 2019. Our data collection began in August 2019 to ensure that fare quotes were obtained over the full sixty-day period before departure for flights departing on October 1st, 2019.

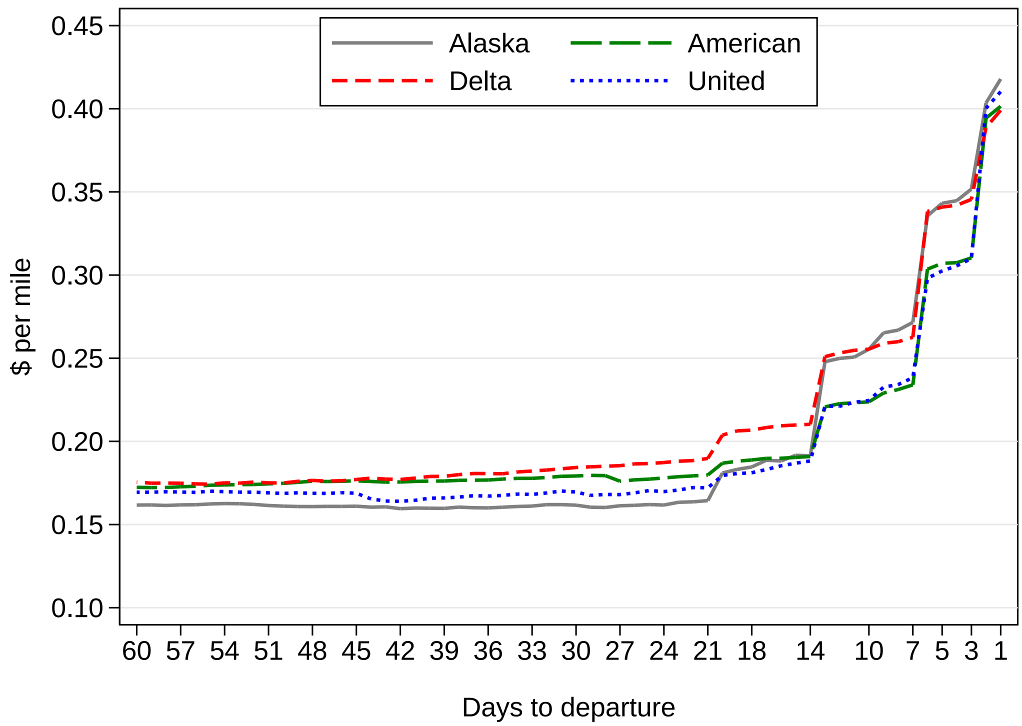
[18] In his analysis of intertemporal price discrimination in monopoly airline markets, Lazarev (2013) employs a six-week data collection window.

[19] Fare quotes for Southwest Airlines are not available on travel aggregator websites such as Expedia, Google Flights, and Kayak.

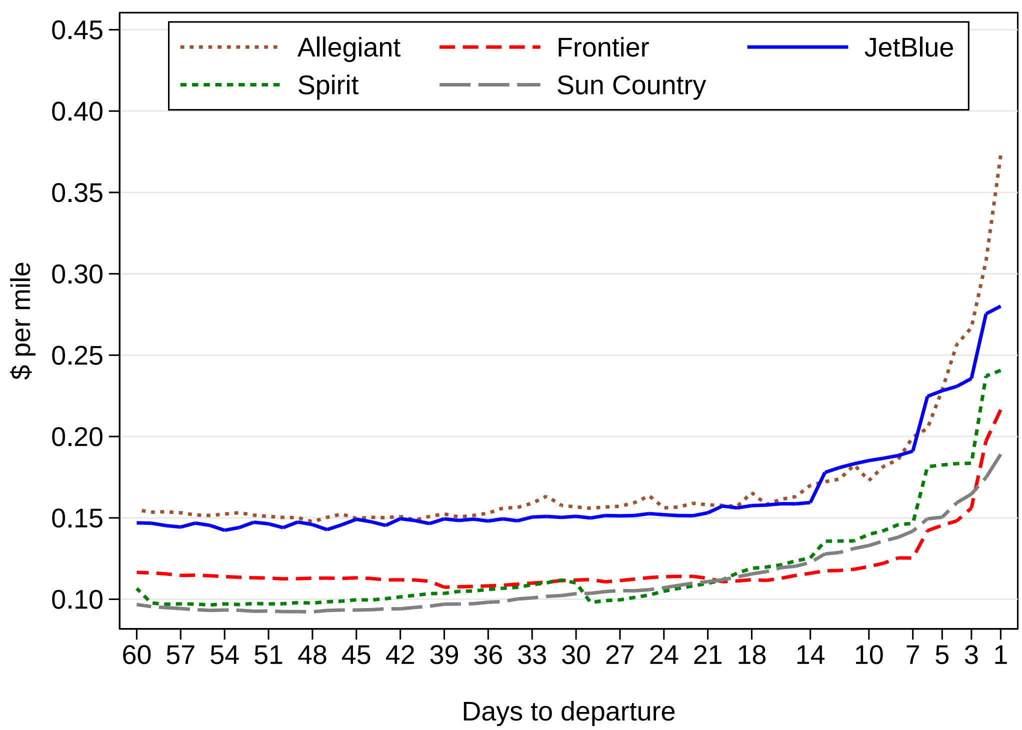
[20] Only nonstop flights were used to generate Figure 2. Of the 21,829,963 observations in our sample, 69.2% (15,106,864) are for nonstop travel.

Figure 2: Average fare per mile during the booking period for nonstop flights

(a) Full-service carriers



(b) Low-cost carriers



fare classes attached to three-week, two-week, and one-week advance-purchase requirements. The last milestone likely reflects intertemporal price discrimination for late booking passengers who have a lower price elasticity of demand (Gaggero, 2010). Furthermore, consistent with the expectation that purchasing passengers are more price inelastic as the departure date approaches, the magnitude of the fare jump monotonically increases as we move across the three-week, two-week, one-week, and three-day fare hike milestones.

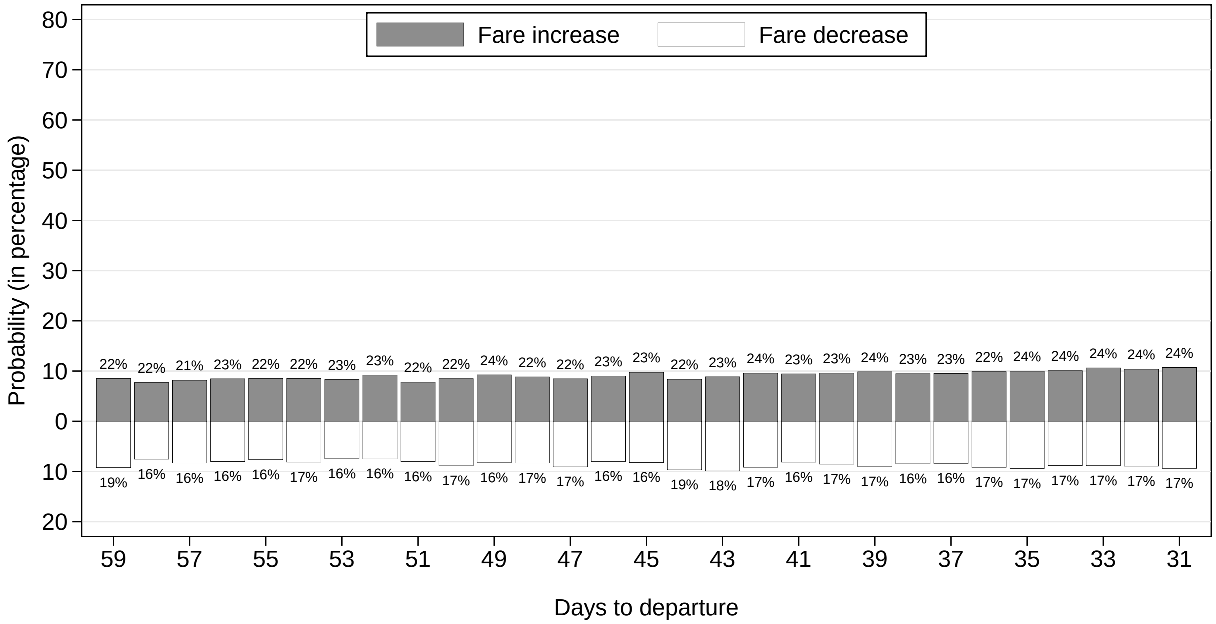
Consistent with their status as a LCC, Allegiant, Frontier, JetBlue, Spirit, and Sun Country all have a lower average fare per mile than the four FSCs (see bottom panel of Figure 2). Allegiant and JetBlue fares are also consistently higher than Frontier, Spirit, and Sun Country fares across the entire sixty-day booking period. Nevertheless, both FSCs and LCCs display similar patterns. Fares are relatively stable until three weeks before departure when fares begin to monotonically increase. In addition, JetBlue and Spirit sharply increase fares at three-week, two-week, one-week, and three-day milestones prior to departure, behavior consistent with Alaska, American, Delta, and United.

To further illustrate how fares evolve in the sixty-day period before departure, Figure 3 displays the probability of observing a fare increase (denoted by a grey bar) or fare decrease (denoted by a white bar) for each day to departure. The number at the top of each gray bar displays the average percentage fare increase, while the number at the bottom of each white bar displays the average percentage fare decrease. For example, the gray bar at 31 days to departure in the top panel of Figure 3 indicates that the fare for 11% of the flights in our sample increased 31 days before departure and the average fare increase was 24%. Similarly, the white bar at 31 days to departure indicates that the fare for 9% of the flights in our sample decreased 31 days before departure and the average fare decrease was 17%.

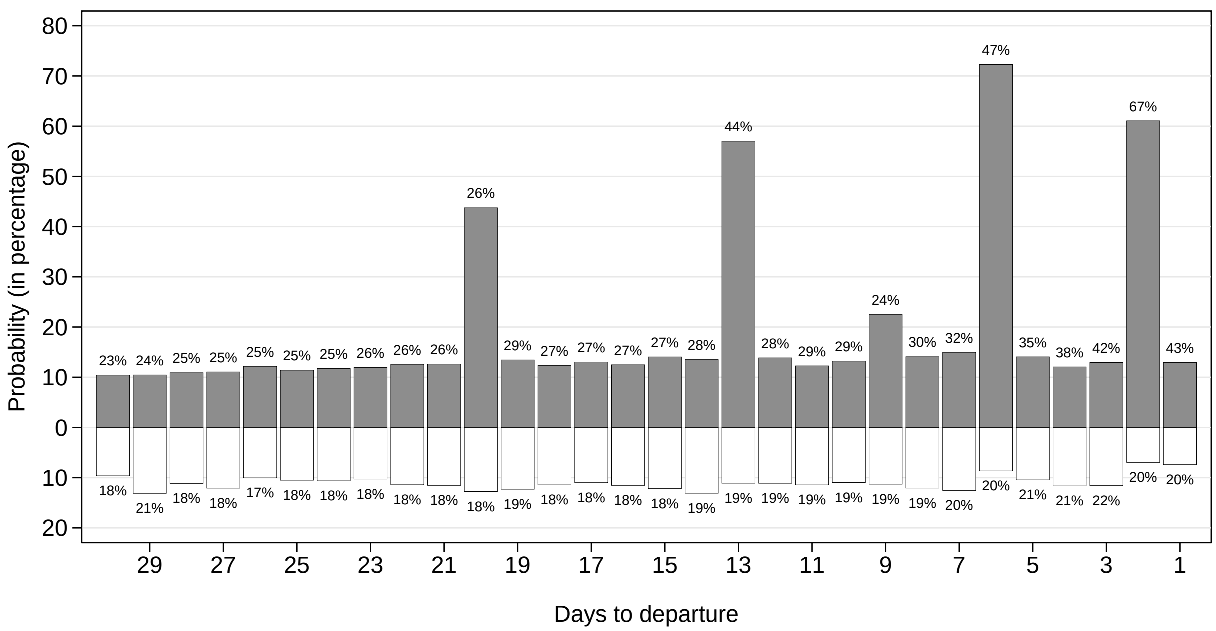
As depicted in the top panel of Figure 3, fares are relatively stable during the early booking period, with the probability of a fare increase hovering around 10% and the probability of a fare decrease at 8% on average. The magnitude of fare increases and decreases are also stable during the early booking period, ranging from 21%-24% for fare increases and 16%-19% for

Figure 3: Probability of observing a fare increase or decrease during the booking period

(a) Early booking period



(b) Late booking period



Notes: Numbers at the top (bottom) of each bar indicate the average percentage fare increase (decrease) for each day to departure. These percentage fare increases and decreases are relative to the flight's fare on the previous day.

fare decreases.

The bottom panel of Figure 3 demonstrates that fare increases and decreases are larger in magnitude and more likely to occur in the last thirty days to departure. Consistent with the fare hikes observed in Figure 2, the probability of observing a fare increase jumps at twenty (44%), thirteen (57%), six (72%), and two (61%) days prior to departure. Moreover, in line with the expectation that demand is more inelastic closer to the date of departure, the average percentage fare increase, in general, monotonically increases from 26% twenty days before departure to 67% two days before departure.

Similar to the early booking period, the probability of observing a fare decrease and the magnitude of the decrease are relatively stable in the last thirty days to departure. During this late booking period, the probability of a fare decrease hovers around 10% with the average fare decrease ranging from 17% to 22%.

Overall, the descriptive analysis of dynamic pricing presented in Figures 2 and 3 reveals two key insights. Foremost, it is important to control for advance-purchase requirements in our empirical analysis of holiday pricing. Most importantly however, if airlines discount flights on major holidays, these discounts are likely to differ with the advance-purchase requirement. For example, if airlines discount flights on federal holidays because price inelastic business travelers are not purchasing tickets when offices are closed, then holiday purchase discounts are likely to be larger in magnitude for flights closer to the date of departure (Bilotkach et al., 2015). In other words, because passengers shopping on a holiday are more likely to be price elastic, high fares that are typically reserved for late arriving business travelers may be heavily discounted to stimulate purchases from these price elastic customers.

5 Empirical Strategy

There are two goals with respect to our empirical analysis. Our first goal is to determine if holiday booking discounts exist, the magnitude of those discounts, and how those discounts are affected by market structure, advance-purchase requirements, and carrier type. Our second goal is to determine if passengers pay substantial premiums for traveling during holiday periods, the magnitude of those premiums, and how those premiums are affected by market structure.

In Section 5.1, we outline the flight fixed effects model used to identify holiday booking discounts. In Section 5.2, we outline the fixed effects model used to identify price premiums for flights that depart during holiday periods (i.e., holiday peak-load pricing).

5.1 Holiday Booking Discounts

To identify holiday booking discounts, we estimate a flight fixed effects model where the variables of interest are the set of dummies that identify each of the twelve major federal and shopping holidays that occur during our sample period (see Table 1 for a detailed list). We estimate equation (1) below,

$$ln(fare)_{fjt} = \alpha + \sum_{i=1}^{4} \delta_i \cdot DaysToDeparture_{ft} + \gamma \cdot WeekendBook_{ft} + \sum_{i=1}^{12} \beta_i \cdot HolidayBook_{ft} + \rho_{fj} + \varepsilon_{fjt} \quad (1)$$

where $ln(fare)_{fjt}$ is the natural logarithm of the published fare measured at the flight or flight-pair (for connecting itineraries) f, directional airport-pair j, and number of days to departure $t \in [1, 60]$, level. $DaysToDeparture$ are a set of dummy variables that indicate if the fare is collected 1-2, 3-6, 7-13, or 14-20 days before departure. The earliest days to departure group (21-60 days) serves as the base category, so that the coefficients on the included $DaysToDeparture$ dummies indicate the change in fare relative to the early booking period.[21] $WeekendBook$ is a dummy indicating whether the fare is collected on a Saturday or

[21] These five days to departure categories correspond to the fare increases observed in Figures 2 and 3. Results are qualitatively similar if we replace the $DaysToDeparture$ dummies with a single variable that indicates the number of days to departure.

Sunday. α is the regression intercept while ε is an error term. Standard errors are clustered at the airport-pair level.

ρ_{fj} is a flight-route fixed effect that controls for any time-invariant flight, carrier, and airport-pair-specific characteristics that affect fares. For example, flight-specific characteristics include the size and type of aircraft used, the scheduled departure and arrival times, and the date of departure. Carrier-specific characteristics include any fare effects attributable to the airline's frequent flyer program, cost structure, and average quality of service. Airport-pair-specific characteristics include the level of competition on the route, whether low-cost carriers are present on the route, distance between the origin and destination airports, and the level of airport dominance at the origin and destination airports.[22]

Table 1: Holidays during our sample period

Holiday	Holiday Type	Date	Day of Week
Labor Day	National	September 2, 2019	Monday
Columbus Day	Federal/State	October 14, 2019	Monday
Veteran's Day	Federal/State	November 11, 2019	Monday
Thanksgiving Day	National	November 28, 2019	Thursday
Black Friday	Shopping	November 29, 2019	Friday
Cyber Monday	Shopping	December 2, 2019	Monday
Christmas Eve	Shopping	December 24, 2019	Tuesday
Christmas Day	National	December 25, 2019	Wednesday
New Year's Eve	Shopping	December 31, 2019	Tuesday
New Year's Day	National	January 1, 2020	Wednesday
Martin Luther King Day	Federal/State	January 20, 2020	Monday
President's Day	Federal/State	February 17, 2020	Monday

Notes: National holidays are days most government and private sector employees receive off from work. Federal/State holidays are days most federal/state government employees receive off from work that private sector employees may or may not receive. Finally, shopping holidays are dates adjacent to a national holiday that are typically associated with high volumes of retail sales. These shopping holidays are also dates that many private and public sector employees decide to take off (i.e., use some of their allotted vacation time).

The variables of interest in equation (1) are the set of $HolidayBook$ dummies that indicate

[22] Note that the ρ_{fj} fixed effect controls for any fare effects attributable to the route's market concentration (typically measured by the Herfindahl-Hirschman Index or a variable counting the number of competitors) in addition to any hub premium that affects fares for all flights operating from the origin and destination airports.

if the fare is published on a holiday. We allow for heterogeneity in fare effects across holidays by including a separate dummy for each of the twelve federal or shopping holidays that occur during our sample period. To further explore heterogeneity in holiday booking discounts, additional specifications examine how these discounts are affected by market structure, the number of days to departure, and carrier type.

5.2 Holiday Peak-Load Pricing

Peak-load pricing is a type of second-degree price discrimination where firms charge a higher price for peak services than off-peak services in an effort to divert high-peak time demands when capacity constraints cause marginal costs to be high (Borenstein and Rose, 1994; Escobari, 2009). In the airline industry, holidays are one period where travel demand is expected to be high ex-ante. For example, the Thanksgiving and Christmas holidays coincide with large volumes of passengers traveling to visit family while holidays observed on a Monday (e.g. Martin Luther King Day, President's Day, Labor Day, and Columbus Day) coincide with large volumes of passengers returning home after enjoying an extended weekend. To determine the extent of peak-load pricing in the days surrounding holiday periods, we estimate equation (2) below,

$$\begin{aligned} ln(fare)_{fjt} = \alpha + \sum_{i=1}^{4} \delta_i \cdot DaysToDeparture_{ft} + \gamma \cdot WeekendBook_{ft} + \beta \cdot HolidayBook_{ft} \\ + \sum_{i=t-3}^{t+3} \theta_i \cdot TravelNationalHoliday_f + \sum_{i=t-3}^{t+3} \eta_i \cdot TravelFederalHoliday_f \\ + \omega_f + \rho_{aj} + \varepsilon_{fjt} \quad (2) \end{aligned}$$

where $ln(fare)_{fjt}$ is the natural logarithm of the published fare measured at the flight or flight-pair (for connecting itineraries) f, directional airport-pair j, and number of days to departure $t \in [1, 60]$, level. Consistent with equation (1), α is the regression intercept, $DaysToDeparture$ are a set of dummy variables that indicate if the fare is published 1-2, 3-6, 7-13, or 14-20 days before departure, $WeekendBook$ is a dummy indicating whether the fare is published on a Saturday or Sunday, ε is an error term, and standard errors are clustered at the airport-pair level.

In contrast to equation (1), $HolidayBook$ is a single dummy that indicates if the fare is published on one of the twelve holidays that occur during our sample period.[23] ω is a matrix containing time-of-day-of-departure, day-of-week-of-departure, and month-of-departure fixed effects.[24] These fixed effects control for any peak-load pricing or seasonal effects that relate to the time-of-day, day-of-week, and month-of-departure.[25] ρ_{aj} is an airline-route fixed-effect that controls for any time-invariant carrier and airport-pair-specific characteristics that affect fares.[26]

The variables of interest in equation (2) are the seven $TravelNationalHoliday$ and seven $TravelFederalHoliday$ dummies that indicate if the departure date of flight or flight-pair f occurs in the three-day period before (t-3, t-2, t-1), the three-day period after (t+1, t+2, t+3), or on the national or federal holiday (t=0).[27]

The distinction between national and federal holidays allows for heterogeneity in peak-load pricing effects across holiday types. Because travel demand is higher during national holidays than federal holidays, we expect the coefficients on the $TravelNationalHoliday$

[23]Because the goal of our peak-load pricing analysis is to determine if price premiums exist for passengers *traveling* on a holiday and *not* if discounts exist for flights *purchased* on a holiday, we replaced the set of 12 holiday booking dummies with a single dummy. However, results are qualitatively similar if we replace the $HolidayBook$ dummy with the set of 12 holiday booking dummies in equation (1).

[24]To control for the time-of-day-of-departure, the departure time for each flight is split into the following four periods: 12:00am-5:59am (night), 6:00am-11:59am (morning), 12:00pm-5:59pm (afternoon), and 6:00pm-11:59pm (evening).

[25]For example, demand is typically high on Mondays and Thursdays due to business travel.

[26]In contrast to equation (1), we are not able to include flight-route fixed effects because they are perfectly collinear with our variables of interest (i.e., the set of $TravelNationalHoliday$ and $TravelFederalHoliday$ dummies).

[27]Referencing Table 1, there are three national holidays during our sample period: Thanksgiving (November 28-29, 2019), Christmas (December 24-25, 2019), and New Year's (December 31, 2019 and January 1, 2020). In addition, there are four federal holidays during our sample period: Columbus Day (October 14, 2019), Veteran's Day (November 11, 2019), Martin Luther King Day (January 20, 2020), and President's Day (February 17, 2020). Because flights in our sample depart between October 1, 2019 and February 29, 2020, we are not able to estimate peak-load pricing effects for flights that depart in the days surrounding Labor Day (September 2, 2019).

dummies to be larger than the coefficients on the $TravelFederalHoliday$ dummies. To further explore heterogeneity in holiday peak-load pricing, additional specifications examine how national and federal holiday travel premiums are affected by market structure.

6 Results

We begin by presenting our baseline holiday booking discount results (Section 6.1). These results are followed by additional specifications that examine how holiday booking discounts are affected by advance-purchase requirements, market structure, and carrier type. Next, results from our analysis that estimates price premiums for traveling during national and federal holiday periods are presented (Section 6.2). Finally, additional specifications examine how these holiday travel premiums are affected by market structure.

6.1 Holiday Booking Discounts

Table 2 presents regression results from the model described by equation (1). All specifications include flight-route fixed effects to control for any time-invariant flight, carrier, and airport-pair-specific characteristics that affect fares. To provide a baseline for the magnitude of advance-purchase discounts, the first column of Table 2 reports results when only the $DaysToDeparture$ dummies and flight-route fixed effects are included. Consistent with Figure 2 and Figure 3, the positive coefficients on the $DaysToDeparture$ dummies provide clear evidence of advance-purchase discounts (i.e., intertemporal price discrimination). Compared to flights purchased 21-60 days before departure, flights purchased 1-2, 3-6, 7-13, and 14-20 days before departure are 128.2%, 76.8%, 35.5%, and 10.7% more expensive, respectively.[28]

[28] Because the dependent variable is in natural log form and the $DaysToDeparture$ variables are dummies, marginal effects are interpreted as the $100(\exp^{\beta} - 1)\%$ change in fare. These results are consistent with Alderighi et al. (2015), Gaggero and Piga (2010), Gillen and Mantin (2009), Luttmann (2019a), and Mantin and Koo (2009) who find that fares begin to substantially increase three weeks prior to departure.

Table 2: Baseline holiday booking effects

	(1)	(2)	(3)	(4)	(5)
DaysToDeparture 1-2	0.825***	0.825***	0.834***	0.825***	0.825***
DaysToDeparture 3-6	0.570***	0.570***	0.574***	0.570***	0.570***
DaysToDeparture 7-13	0.304***	0.304***	0.303***	0.304***	0.304***
DaysToDeparture 14-20	0.102***	0.102***	0.102***	0.102***	0.102***
WeekendBook		0.001	0.001	0.001	0.001
HolidayBook		-0.018***	-0.013***		
HolidayBook * DaysToDeparture 1-2			-0.125***		
HolidayBook * DaysToDeparture 3-6			-0.049***		
HolidayBook * DaysToDeparture 7-13			0.020***		
HolidayBook * DaysToDeparture 14-20			0.003		
Book on Labor Day				-0.015***	-0.017***
Book on Columbus Day				0.025***	0.021***
Book on Veteran's Day				0.009***	0.007**
Book on Thanksgiving				-0.016***	-0.016***
Book on Black Friday				-0.023***	-0.025***
Book on Cyber Monday				-0.009***	-0.007***
Book on Christmas Eve				-0.061***	-0.058***
Book on Christmas Day				-0.061***	-0.059***
Book on New Year's Eve				-0.048***	-0.043***
Book on New Year's Day				-0.041***	-0.036***
Book on M.L. King Day				0.049***	0.047***
Book on President's Day				0.009	0.009
LCC * Book on Labor Day					0.008
LCC * Book on Columbus Day					0.018***
LCC * Book on Veteran's Day					0.012***
LCC * Book on Thanksgiving					0.002
LCC * Book on Black Friday					0.007
LCC * Book on Cyber Monday					-0.008
LCC * Book on Christmas Eve					-0.016**
LCC * Book on Christmas Day					-0.007
LCC * Book on New Year's Eve					-0.026***
LCC * Book on New Year's Day					-0.024***
LCC * Book on M.L. King Day					0.013**
LCC * Book on President's Day					-0.002
R^2	0.420	0.420	0.421	0.421	0.421
Observations	21,829,963	21,829,963	21,829,963	21,829,963	21,829,963

Notes: The dependent variable is the natural logarithm of fare. Marginal effects are interpreted as the $100(\exp^{\beta}-1)\%$ change in fare. All specifications include flight-route fixed effects that control for any time-invariant flight, carrier, and airport-pair-specific characteristics that affect fares. Standard errors are clustered at the airport-pair level. Due to space constraints, the regression constant is not reported and standard errors are provided in Appendix Table B1. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

The second column of Table 2 adds the $WeekendBook$ and $HolidayBook$ indicators to the specification presented in column (1). Contrary to the results in Puller and Taylor (2012), but consistent with Mantin and Koo (2010), we find that economy fares published (i.e., "purchased" or "booked") on a weekend (Saturday-Sunday) are not statistically different from fares published during the workweek (Monday-Friday). The analysis in Puller and Taylor (2012) relied on detailed transacted fare data from the fourth quarter of 2004, a timeframe prior to the mergers between US Airways and America West, Delta and Northwest, United and Continental, Southwest and AirTran, American and US Airways, and Alaska and Virgin America. While uncertainty exists whether fares in our sample were purchased at the published rates, our results suggest that the weekend purchase discount may no longer hold in the newly consolidated U.S. airline industry.

The negative and statistically significant coefficient on $HolidayBook$ in column (2) of Table 2 indicates that fares published on a federal or shopping holiday are 1.8% cheaper than fares published on non-holiday dates, supporting the conjecture that airlines price discriminate when the mix of purchasing passengers makes demand more elastic. To determine if the holiday discount differs with how far in advance airfare is booked, column (3) presents results when $HolidayBook$ is interacted with the $DaysToDeparture$ dummies. We find substantial heterogeneity in the magnitude of the holiday booking discount, ranging from no discount for flights booked 7-13 days in advance to 12.9% for flights booked 1-2 days in advance. In addition, flights booked on a holiday with 3-6, 14-20, or 21-60 day advance-purchase requirements are 6.0%, 1.0%, and 1.3% cheaper, respectively.

It is not surprising to find that the holiday booking discount is largest for flights booked 1-2 or 3-6 days prior to departure. Because passengers shopping on a holiday are more likely to be price elastic, high fares typically reserved for late arriving business travelers must be heavily discounted to stimulate purchases from these price elastic customers.

To determine if holiday booking discounts differ across holidays, column (4) of Table 2 replaces the $HolidayBook$ indicator with separate indicators for each of the twelve federal and shopping holidays that occur during our sample period. We find substantial heterogeneity in holiday discounts ranging from 0.9% for fares booked on Cyber Monday to 5.9% for fares booked on Christmas Eve or Christmas Day. Although we estimate fare premiums ranging from 0.9% to 5.0% for flights booked on Martin Luther King Day, President's Day, Columbus Day, and Veteran's Day, not all private sector or state government employers observe these federal holidays.[29] Therefore, it is not surprising to find that holiday booking discounts do not extend to these four holidays.

The last column of Table 2 presents results when the holiday booking effects are allowed to vary between FSCs (Alaska, American, Delta, and United) and LCCs (Allegiant, Frontier, JetBlue, Spirit, and Sun Country). Consistent with column (4), the positive coefficients on the Martin Luther King, President's, Columbus, and Veteran's Day variables indicate that both carrier types do not discount fares on these four federal holidays. Furthermore, the statistically insignificant coefficients on the Labor Day, Thanksgiving Day, Black Friday, Cyber Monday, and Christmas Day interaction terms suggests that FSCs and LCCs do not differ in average discounts offered on these five holidays. Similar to the column (4) results, published fares are 1.7%, 1.6%, 2.5%, 0.7% and 5.7% cheaper on Labor Day, Thanksgiving Day, Black Friday, Cyber Monday, and Christmas Day respectively.

However, the negative and statistically significant coefficients on the Christmas Eve, New Year's Eve, and New Year's Day interactions in column (5) of Table 2 indicate that LCCs offer larger discounts than FSCs on these three holidays. On Christmas Eve fares for LCCs are 7.1% cheaper compared to 5.6% cheaper for FSCs. On New Year's Eve and New Year's day, LCC fares are 6.7% and 5.8% cheaper compared to 4.2% and 3.5% cheaper for FSCs.

[29]For example, employees of The MITRE Corporation (the current employer for one of the author's of this study) currently do not receive President's Day or Columbus Day off from work. Many state government employees (e.g., California, Oregon, South Carolina, Texas, and Washington, among others) do not receive Columbus Day off. According to the Bureau of Labor Statistics, full-time private-sector employees receive an average of 7.6 paid federal holidays (`https://www.bls.gov/news.release/ebs.t05.htm`).

6.1.1 Holiday Booking Discounts and Southwest Presence

There may be a concern that the results in Table 2 are biased due to our lack of available fare data from Southwest.[30] To examine this possibility, Table 3 presents results when the advance-purchase and holiday booking effects are allowed to vary across two types of markets: markets where Southwest is present (i.e., airport-pairs where Southwest provides nonstop service) and markets where Southwest is not present (i.e., airport-pairs that Southwest does not serve nonstop).

Column (1) of Table 3 presents results when the specification in column (1) of Table 2 is augmented to include interactions between the $DaysToDeparture$ dummies and the Southwest presence indicator.[31] The statistically insignificant coefficients on the 7-13 and 14-20 interactions indicates that the presence of Southwest does not affect average fare hikes for flights purchased 7-20 days before departure. However, the negative and statistically significant coefficients on the 1-2 and 3-6 interaction terms indicates that the presence of Southwest dampens average fare premiums for flights within one-week of departure. Compared to flights purchased 21-60 days before departure, flights purchased 1-2 days before departure are 137.0% more expensive in markets without Southwest compared to 116.4% more expensive in markets where Southwest is present. Similarly, flights purchased 3-6 days before departure are 83.7% more expensive in markets without Southwest compared to 67.2% more expensive in markets where Southwest is present.

Column (2) of Table 3 presents results when $WeekendBook$, $HolidayBook$, and the interaction between $HolidayBook$ and $Southwest$ are added to the specification in column (1). The small and statistically insignificant coefficient on $HolidayBook * Southwest$ indicates that average holiday booking discounts do not differ across markets where Southwest is present and markets where Southwest is not present. Similar to the results in column (2) of Table 2, fares published on a federal or shopping holiday are 1.8% cheaper in both types

[30]For example, competition from Southwest has been shown to have large negative fare effects (Brueckner et al., 2013; Goolsbee and Syverson, 2008; Morrison, 2001; Kwoka et al., 2016).

[31]The Southwest presence indicator itself is not separately identified from the flight-route fixed effects.

of markets.

In Table 2, holiday booking discounts were found to differ with how far in advance airfare is purchased, with the largest discounts reserved for flights within one-week of departure. To determine if the presence of Southwest affects these holiday booking discounts, column (3) of Table 3 presents results when the $HolidayBook * DaysToDeparture$ interaction terms are interacted with the Southwest presence indicator. In this specification, the $HolidayBook * Southwest$ and $HolidayBook * DaysToDeparture * Southwest$ interactions are all statistically insignificant, providing further evidence that the presence of Southwest does not affect average holiday booking discounts.

6.1.2 Holiday Booking Discounts and Connecting Flights

Our baseline results in Table 2 constrain the advance-purchase and holiday booking effects to be constant across nonstop and connecting trips. However, because the quality of nonstop and connecting trips differ, it is possible that the advance-purchase and holiday booking effects differ between these two types of trips (Luttmann, 2019a). To examine this possibility, Table 4 presents results when the advance-purchase and holiday booking effects are allowed to vary across nonstop and connecting trips.

Column (1) of Table 4 presents results when the specification in column (1) of Table 2 is augmented to include interactions between the $DaysToDeparture$ dummies and the connecting trip indicator.[32] The statistically insignificant coefficient on the 14-20 interaction term indicates that trip type does not affect average fare hikes for flights purchased 14-20 days before departure. However, the negative and statistically significant coefficients on the 1-2, 3-6, and 7-13 interactions indicates that fare hikes for flights purchased within two weeks of departure are larger for nonstop trips. Compared to flights purchased 21-60 days before departure, flights purchased 1-2 days before departure are 144.2% more expensive for nonstop trips and 87.6% more expensive for connecting trips. Similarly, flights purchased 3-6

[32] The connecting trip indicator itself is not separately identified from the flight-route fixed effects.

Table 3: Holiday booking effects and the presence of Southwest

	(1)	(2)	(3)
DaysToDeparture 1-2	0.863***	0.863***	0.871***
DaysToDeparture 3-6	0.608***	0.608***	0.612***
DaysToDeparture 7-13	0.314***	0.314***	0.312***
DaysToDeparture 14-20	0.101***	0.101***	0.101***
DaysToDeparture 1-2 * Southwest	-0.091**	-0.091**	-0.090**
DaysToDeparture 3-6 * Southwest	-0.094*	-0.094*	-0.095*
DaysToDeparture 7-13 * Southwest	-0.024	-0.024	-0.024
DaysToDeparture 14-20 * Southwest	0.004	0.004	0.004
WeekendBook		0.001	0.001
HolidayBook		-0.018***	-0.013***
HolidayBook * Southwest		0.0003	0.001
HolidayBook * DaysToDeparture 1-2			-0.122***
HolidayBook * DaysToDeparture 3-6			-0.051***
HolidayBook * DaysToDeparture 7-13			0.023***
HolidayBook * DaysToDeparture 14-20			0.001
HolidayBook * DaysToDeparture 1-2 * Southwest			-0.008
HolidayBook * DaysToDeparture 3-6 * Southwest			0.007
HolidayBook * DaysToDeparture 7-13 * Southwest			-0.007
HolidayBook * DaysToDeparture 14-20 * Southwest			0.003
R^2	0.422	0.422	0.422
Observations	21,829,963	21,829,963	21,829,963

Notes: The dependent variable is the natural logarithm of fare. Marginal effects are interpreted as the $100(\exp^{\beta} - 1)\%$ change in fare. All specifications include flight-route fixed effects that control for any time-invariant flight, carrier, and airport-pair-specific characteristics that affect fares. Standard errors are clustered at the airport-pair level. Due to space constraints, the regression constant is not reported and standard errors are provided in Appendix Table B2. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

days before departure are 84.8% more expensive for nonstop trips and 53.7% more expensive for connecting trips. Finally, flights purchased 7-13 days before departure are 37.6% more expensive for nonstop trips and 28.0% more expensive for connecting trips.

Column (2) of Table 4 presents results when $WeekendBook$, $HolidayBook$, and the interaction between $HolidayBook$ and the connecting trip indicator are added to the specification in column (1). The positive and statistically significant coefficient on $HolidayBook*Connect$ indicates that holiday booking discounts are larger for nonstop trips. Compared to fares published on non-holiday dates, fares published on a federal or shopping holiday are 2.0% cheaper for nonstop trips and 1.6% cheaper for connecting trips.

In Table 2, holiday booking discounts differed with how far in advance airfare is purchased, with the largest discounts reserved for flights within one-week of departure. To determine if these holiday booking discounts differ across nonstop and connecting trips, column (3) of Table 4 presents results when the $HolidayBook * DaysToDeparture$ interaction terms are interacted with the connecting trip indicator. In this specification, the $HolidayBook * Connect$ and $HolidayBook * DaysToDeparture * Connect$ interactions attached to the 1-2, 7-13, and 14-20 advance-purchase requirements are all statistically insignificant, implying that average holiday booking discounts do not differ across nonstop and connecting trips for flights purchased 1-2 or 7-60 days before departure. However, the $HolidayBook * DaysToDeparture$ 3-6$*Connect$ coefficient is positive and statistically significant, indicating that holiday booking discounts are larger for nonstop trips purchased 3-6 days before departure. Compared to flights purchased 21-60 days before departure, flights purchased 3-6 days before departure are 7.4% cheaper for nonstop trips and 3.9% cheaper for connecting trips.

6.1.3 Competition and Holiday Booking Discounts

The results in Tables 2, 3, and 4 provide evidence consistent with airlines price discriminating on several major holidays when the mix of purchasing passengers is expected to be more price elastic. To determine how holiday booking discounts are affected by the level of competition, Table 5 presents results when the specification in column (3) of Table 2 is estimated under different market structures. Although classical economic theory predicts that the extent of price discrimination should decrease with competition because incumbent firms find it more difficult to maintain markups over marginal cost as new competitors enter, the predicted effect in oligopolistic markets is ambiguous (Borenstein, 1985; Chandra and Lederman, 2018; Holmes, 1989; Stole, 2007).

Columns (1)-(3) of Table 5 present results when the specification in column (3) of Table 2 is estimated on the subsamples of concentrated markets (column one), competitive markets

Table 4: Holiday booking effects and connecting flights

	(1)	(2)	(3)
DaysToDeparture 1-2	0.893***	0.893***	0.902***
DaysToDeparture 3-6	0.614***	0.614***	0.619***
DaysToDeparture 7-13	0.319***	0.319***	0.317***
DaysToDeparture 14-20	0.104***	0.104***	0.104***
DaysToDeparture 1-2 * Connect	-0.264***	-0.264***	-0.265***
DaysToDeparture 3-6 * Connect	-0.184***	-0.184***	-0.187***
DaysToDeparture 7-13 * Connect	-0.072***	-0.072***	-0.072***
DaysToDeparture 14-20 * Connect	-0.015	-0.015	-0.015
WeekendBook		0.001	0.001
HolidayBook		-0.020***	-0.013***
HolidayBook * Connect		0.004**	0.001
HolidayBook * DaysToDeparture 1-2			-0.130***
HolidayBook * DaysToDeparture 3-6			-0.061***
HolidayBook * DaysToDeparture 7-13			0.020***
HolidayBook * DaysToDeparture 14-20			0.002
HolidayBook * DaysToDeparture 1-2 * Connect			0.015
HolidayBook * DaysToDeparture 3-6 * Connect			0.034***
HolidayBook * DaysToDeparture 7-13 * Connect			0.002
HolidayBook * DaysToDeparture 14-20 * Connect			0.003
R^2	0.428	0.428	0.428
Observations	21,829,963	21,829,963	21,829,963

Notes: The dependent variable is the natural logarithm of fare. Marginal effects are interpreted as the $100(\exp^{\beta} - 1)\%$ change in fare. All specifications include flight-route fixed effects that control for any time-invariant flight, carrier, and airport-pair-specific characteristics that affect fares. Standard errors are clustered at the airport-pair level. Due to space constraints, the regression constant is not reported and standard errors are provided in Appendix Table B3. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

(column two), and highly competitive markets (column three).[33] Because holiday booking discounts were found to differ between nonstop and connecting trips in Table 4, Table 5 presents results when the analysis is restricted to include only nonstop flights.

In columns (1)-(3), we find substantial heterogeneity in holiday booking discounts by market type, with the discount monotonically increasing from 1.5% in concentrated markets

[33] Each market is defined based on the number of nonstop carriers serving the route on the observed date. Concentrated markets are airport-pairs served by one or two nonstop carriers (i.e., monopoly or duopoly), competitive markets are airport-pairs served by three nonstop carriers (i.e., triopoly), and highly competitive markets are airport-pairs served by four or more nonstop carriers. In contrast to many previous studies, our data allows us to construct daily market structure measures.

Table 5: Holiday booking with days to departure under different market structures

	(1) Conctr.	(2) Compet.	(3) Highly compet.	(4) Conctr.	(5) Compet.	(6) Highly compet.
DaysToDeparture 1-2	0.848***	0.912***	0.897***	0.855***	0.921***	0.907***
DaysToDeparture 3-6	0.670***	0.656***	0.576***	0.675***	0.660***	0.581***
DaysToDeparture 7-13	0.381***	0.364***	0.277***	0.379***	0.362***	0.276***
DaysToDeparture 14-20	0.133***	0.104***	0.096***	0.133***	0.104***	0.095***
WeekendBook	0.0004	0.002**	0.0004	0.0004	0.002**	0.0004
HolidayBook	-0.015***	-0.017***	-0.022***	-0.010**	-0.011***	-0.016***
HolidayBook * DaysToDep. 1-2				-0.099***	-0.133***	-0.138***
HolidayBook * DaysToDep. 3-6				-0.080***	-0.045***	-0.061***
HolidayBook * DaysToDep. 7-13				0.033**	0.019*	0.018***
HolidayBook * DaysToDep. 14-20				0.003	-0.009	0.008**
R^2	0.508	0.455	0.415	0.508	0.455	0.415
Observations	2,483,465	4,305,945	8,317,454	2,483,465	4,305,945	8,317,454

Notes: The analysis sample in columns (1) and (4) are the subsample of nonstop flights in concentrated markets (i.e., monopoly and duopoly airport-pairs). The analysis sample in columns (2) and (5) are the subsample of nonstop flights in competitive markets (i.e., triopoly airport-pairs). The analysis sample in columns (3) and (6) are the subsample of nonstop flights in highly competitive markets (i.e., airport-pairs with four or more nonstop competitors). The dependent variable is the natural logarithm of fare. Marginal effects are interpreted as the $100(\exp^{\beta} - 1)\%$ change in fare. All specifications include flight-route fixed effects that control for any time-invariant flight, carrier, and airport-pair-specific characteristics that affect fares. Standard errors are clustered at the airport-pair level. Due to space constraints, the regression constant is not reported and standard errors are provided in Appendix Table B4. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

to 2.2% in highly competitive markets.

When holiday booking discounts are allowed to vary by advance-purchase requirements in columns (4)-(6) of Table 5, we find that flights purchased on a holiday that are 1-2 days before departure are 10.3% cheaper in concentrated markets, 13.4% cheaper in competitive markets, and 14.3% cheaper in highly competitive markets.

Flights purchased on a holiday that are 3-6 days before departure are 8.6% cheaper in concentrated markets, 5.4% cheaper in competitive markets, and 7.4% cheaper in highly competitive markets.

Flights purchased on a holiday that are 14-20 days before departure are 0.7% cheaper in concentrated markets, 2.0% cheaper in competitive markets, and 0.8% cheaper in highly competitive markets.

Flights purchased on a holiday that are 21-60 days before departure are 1.0% cheaper in concentrated markets, 1.1% cheaper in competitive markets, and 1.6% cheaper in highly competitive markets. In general, holiday purchase discounts do not extend to flights that are purchased 7-13 days before departure.

To further explore how holiday purchase discounts are affected by competition and carrier type, Table 6 presents results when the specification in column (5) of Table 2 is estimated under different market structures. Consistent with Table 2, the positive or statistically insignificant coefficients on the Martin Luther King, President's, Columbus, and Veteran's Day variables across all columns in Table 6 indicate that both FSCs and LCCs do not discount fares on these four federal holidays.

On other federal and shopping holidays, we find considerable heterogeneity in holiday booking discounts by market and carrier type. FSC (LCC) flights purchased on Christmas Eve are 6.4% (8.1%) cheaper in concentrated markets, 5.7% (8.1%) cheaper in competitive markets, and 6.1% (8.2%) cheaper in highly competitive markets. FSC (LCC) flights purchased on Christmas Day are 6.1% (7.3%) cheaper in concentrated markets, 5.7% (7.4%) cheaper in competitive markets, and 6.4% (7.9%) cheaper in highly competitive markets.

FSC (LCC) flights purchased on New Year's Eve are 3.1% (6.4%) cheaper in concentrated markets, 4.5% (7.9%) cheaper in competitive markets, and 4.7% (7.2%) cheaper in highly competitive markets. FSC (LCC) flights purchased on New Year's Day are 2.8% (4.8%) cheaper in concentrated markets, 3.9% (6.9%) cheaper in competitive markets, and 4.4% (6.9%) cheaper in highly competitive markets.

FSC flights purchased on Thanksgiving (Black Friday) are 1.2% (1.9%) cheaper in concentrated markets, 1.1% (1.7%) cheaper in competitive markets, and 2.2% (3.3%) cheaper in highly competitive markets. However, FSC flights purchased on Cyber Monday are only discounted in highly competitive markets (1.2% cheaper). Similarly, FSC flights purchased on Labor Day are only discounted in highly competitive markets (2.4% cheaper).

Table 6: Holiday booking and LCCs under different market structures

	(1) Concentrated	(2) Competitive	(3) Highly competitive
DaysToDeparture 1-2	0.848***	0.911***	0.897***
DaysToDeparture 3-6	0.669***	0.656***	0.576***
DaysToDeparture 7-13	0.381***	0.363***	0.276***
DaysToDeparture 14-20	0.133***	0.103***	0.095***
WeekendBook	0.0003	0.002**	0.0004
Book on Labor Day	-0.023	-0.017	-0.024***
Book on Columbus Day	0.019	0.028***	0.028***
Book on Veteran's Day	0.009	0.016*	0.006
Book on Thanksgiving	-0.012*	-0.011*	-0.022***
Book on Black Friday	-0.019***	-0.017***	-0.034***
Book on Cyber Monday	0.008	0.003	-0.012***
Book on Christmas Eve	-0.066***	-0.059***	-0.063***
Book on Christmas Day	-0.063***	-0.059***	-0.066***
Book on New Year's Eve	-0.032***	-0.046***	-0.048***
Book on New Year's Day	-0.028***	-0.040***	-0.045***
Book on M.L. King Day	0.051***	0.045***	0.050***
Book on President's Day	0.026	-0.001	0.024*
LCC * Book on Labor Day	-0.024	0.025	0.013
LCC * Book on Columbus Day	0.035**	0.033**	0.006
LCC * Book on Veteran's Day	0.011	0.017	0.010
LCC * Book on Thanksgiving	-0.003	-0.018*	0.019**
LCC * Book on Black Friday	0.007	-0.019	0.029***
LCC * Book on Cyber Monday	-0.046**	-0.024**	0.017**
LCC * Book on Christmas Eve	-0.018	-0.025**	-0.023**
LCC * Book on Christmas Day	-0.013	-0.018	-0.016
LCC * Book on New Year's Eve	-0.034***	-0.036***	-0.027***
LCC * Book on New Year's Day	-0.021*	-0.032***	-0.027***
LCC * Book on M.L. King Day	-0.0004	0.027*	0.023**
LCC * Book on President's Day	-0.022	-0.033	-0.044
R^2	0.509	0.456	0.416
Observations	2,483,465	4,305,945	8,317,454

Notes: The analysis sample in column (1) is the subsample of nonstop flights in concentrated markets (i.e., monopoly and duopoly airport-pairs). The analysis sample in column (2) is the subsample of nonstop flights in competitive markets (i.e., triopoly airport-pairs). The analysis sample in column (3) is the subsample of nonstop flights in highly competitive markets (i.e., airport-pairs with four or more nonstop competitors). The dependent variable is the natural logarithm of fare. Marginal effects are interpreted as the $100(\exp^{\beta} - 1)\%$ change in fare. All specifications include flight-route fixed effects that control for any time-invariant flight, carrier, and airport-pair-specific characteristics that affect fares. Standard errors are clustered at the airport-pair level. Due to space constraints, the regression constant is not reported and standard errors are provided in Appendix Table B5. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Finally, we find substantial heterogeneity in holiday purchase discounts by market type for LCCs on Labor Day, Thanksgiving, Black Friday, and Cyber Monday. The generally positive or statistically insignificant coefficients on Labor Day, Thanksgiving, and Black Friday indicate that LCCs offer no additional discount above the discount offered by FSCs on these three holidays. In contrast, LCC flights purchased on Cyber Monday are 3.7% cheaper in concentrated markets, 2.1% cheaper in competitive markets, and not discounted in highly competitive markets.

6.2 Holiday Peak-Load Pricing

Table 7 presents regression results from the model described by equation (2). All specifications include airline-route, time-of-day-of-departure, day-of-week-of-departure, and month-of-year fixed effects. To provide a baseline for holiday peak-load pricing, the first column of Table 7 reports results when estimation is performed on the full sample of nonstop and connecting flights. Consistent with the hypothesis that airlines engage in peak-load pricing on national and federal holidays, the positive and statistically significant coefficients on $TravelNationalHoliday$ and $TravelFederalHoliday$ indicate that passengers traveling on the date of a national or federal holiday face higher fares. Moreover, consistent with the expectation that travel demand is higher on national holidays, the estimated national holiday premium (56.8%) is larger than the federal holiday premium (35.0%). This finding does not change if we restrict the analysis to the subsample of nonstop flights in column (2). In this specification, the national holiday travel premium is 53.1% and the federal holiday travel premium is 35.8%.

More interesting patterns of peak-load pricing behavior are observed in the days preceding and following a national holiday. Relative to non-holiday departures, flights departing one day before a national holiday are 72.5% more expensive while flights departing one day after are 82.0% more expensive.[34] In other words, traveling one day before (after) a national

[34] Qualitatively similar results are obtained when removing connecting flights from the analysis sample in

holiday is 27.5% (44.3%) more expensive than traveling on the national holiday itself. This result is sensible considering that passengers generally prefer to avoid flying on Thanksgiving Day, Christmas Day, and New Year's Day. We also find that travel premiums monotonically decrease as the departure date moves further away from the national holiday. Relative to non-holiday departures, traveling two days before (after) a national holiday is 56.8% (71.1%) more expensive while traveling three days before (after) is 41.6% (55.3%) more expensive.

A different pattern of peak-load price variation is observed during federal holiday periods. Relative to non-holiday departures, traveling one day before a federal holiday is 4.6% more expensive while traveling one day after is 9.6% more expensive.[35] These travel premiums are substantially smaller than the 35.0% premium for traveling on the federal holiday itself. In contrast to the pattern of national holiday premiums, the negative coefficients on the $t+2$ and $t+3$ $TravelFederalHoliday$ variables indicate that passengers do not pay a premium for traveling two or three days after a federal holiday. We also find that travel premiums monotonically increase in the days preceding a federal holiday with the largest premium (29.2%) occurring three days before. This result is not surprising considering that all federal holidays in our sample occurred on Mondays (see Table 1). Since holidays observed on a Monday coincide with large volumes of passengers returning home after enjoying an extended weekend, the largest premiums are expected to occur on the Friday and Monday of the holiday weekend.

6.2.1 Competition and Holiday Peak-Load Pricing

The last three columns of Table 7 examine how holiday travel premiums are affected by market structure. Column (3) presents results when the specification in column (2) is estimated on the subsample of concentrated markets (i.e., monopoly and duopoly airport-pairs), column (4) the subsample of competitive markets (i.e., triopoly airport-pairs), and column

column (2).

[35] Qualitatively similar results are obtained when removing connecting flights from the analysis sample in column (2).

Table 7: Peak-load pricing for traveling during holiday periods

	(1) All flights	(2) Nonstop flights	(3) Concentrated	(4) Competitive	(5) Highly competitive
DaysToDeparture 1-2	0.810***	0.884***	0.842***	0.902***	0.888***
DaysToDeparture 3-6	0.552***	0.610***	0.667***	0.652***	0.571***
DaysToDeparture 7-13	0.295***	0.317***	0.380***	0.362***	0.274***
DaysToDeparture 14-20	0.099***	0.103***	0.133***	0.103***	0.094***
WeekendBook	0.0003	0.001	0.0001	0.002*	0.0003
HolidayBook	-0.022***	-0.021***	-0.017***	-0.019***	-0.023***
TravelNationalHoliday t-3	0.348***	0.333***	0.290***	0.330***	0.343***
TravelNationalHoliday t-2	0.450***	0.445***	0.427***	0.463***	0.441***
TravelNationalHoliday t-1	0.545***	0.539***	0.488***	0.542***	0.551***
TravelNationalHoliday	0.450***	0.426***	0.367***	0.449***	0.434***
TravelNationalHoliday t+1	0.599***	0.579***	0.545***	0.587***	0.582***
TravelNationalHoliday t+2	0.537***	0.531***	0.481***	0.528***	0.547***
TravelNationalHoliday t+3	0.440***	0.430***	0.453***	0.448***	0.417***
TravelFederalHoliday t-3	0.256***	0.263***	0.279***	0.257***	0.260***
TravelFederalHoliday t-2	0.134***	0.156***	0.160***	0.163***	0.146***
TravelFederalHoliday t-1	0.045***	0.043***	0.042	0.065*	0.031
TravelFederalHoliday	0.300***	0.306***	0.279***	0.312***	0.310***
TravelFederalHoliday t+1	0.092***	0.097***	0.093***	0.121***	0.084***
TravelFederalHoliday t+2	-0.024***	-0.034***	-0.046***	-0.015	-0.039***
TravelFederalHoliday t+3	-0.019**	-0.022**	-0.031	-0.015	-0.025**
R^2	0.585	0.566	0.574	0.523	0.587
Observations	21,829,963	15,106,864	2,483,465	4,305,945	8,317,454

Notes: The analysis sample in column (2) is the subsample of nonstop flights. The analysis sample in column (3) is the subsample of nonstop flights in concentrated markets (i.e., monopoly and duopoly airport-pairs). The analysis sample in column (4) is the subsample of nonstop flights in competitive markets (i.e., triopoly airport-pairs). The analysis sample in column (5) is the subsample of nonstop flights in highly competitive markets (i.e., airport-pairs with four or more nonstop competitors). The dependent variable is the natural logarithm of fare. Marginal effects are interpreted as the $100(\exp^{\beta} - 1)\%$ change in fare. All specifications include airline-route, time-of-day-of-departure, day-of-week-of-departure, and month-of-year fixed effects. Standard errors are clustered at the airport-pair level. Due to space constraints, the regression constant is not reported and standard errors are provided in Appendix Table B6. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

(5) the subsample of highly competitive markets (i.e., airport-pairs served by four or more nonstop carriers).

On national holidays, we find that travel premiums are lowest in concentrated markets (44.3%) and largest in competitive (56.7%) and highly competitive markets (54.3%). These findings are sensible considering that average fare levels are already high in concentrated markets, implying that monopolists and duopolists have less room to maneuver fares during high demand periods.

Consistent with the findings in columns (1) and (2) of Table 7, we find that travel premiums monotonically decrease as the departure date moves further away from the national holiday across all market types. Relative to non-holiday departures, fares for flights departing one day before (after) a national holiday are 62.9% (72.5%) higher in concentrated markets, 71.9% (79.9%) higher in competitive markets, and 73.5% (79.0%) higher in highly competitive markets. Fares for flights departing two (three) days before a national holiday are 53.3% (33.6%) higher in concentrated markets, 58.9% (39.1%) higher in competitive markets, and 55.4% (40.9%) higher in highly competitive markets. Flights departing two (three) days after a national holiday are 61.8% (57.3%) higher in concentrated markets, 69.6% (56.5%) higher in competitive markets, and 72.8% (51.7%) higher in highly competitive markets.

The relationship between market structure and holiday travel premiums is not as clear during federal holiday periods. Relative to non-holiday departures, fares for flights departing on a federal holiday are 32.2% higher in concentrated markets, 36.6% higher in competitive markets, and 36.3% higher in highly competitive markets. Fares for flights departing one day after a federal holiday are 9.7% higher in concentrated markets, 12.9% higher in competitive markets, and 8.8% higher in highly competitive markets. Fares for flights departing one day before a federal holiday are generally not statistically different from non-holiday departures, except in competitive markets where fares are 6.5% higher. Fares for flights departing two (three) days before a federal holiday are 17.4% (32.2%) higher in concentrated markets, 17.7% (29.3%) higher in competitive markets, and 15.7% (29.7%) higher in highly competitive markets. Consistent with columns (1) and (2), there is no premium for traveling two or three days after a federal holiday across all market types.

7 Conclusion

Sales during Thanksgiving, Christmas, and other holiday periods are common in a variety of retail markets. In this article, we examined whether holiday discounts also occur in the airline industry. Because business travelers are unlikely to purchase tickets outside of normal business hours, federal holidays provide airlines with an opportunity to practice third-degree price discrimination by offering discounts to passengers who purchase on these dates. Exploiting a unique panel of almost 22 million fares collected over a seven-month period, we find that fares published on a federal holiday are 1.8% cheaper, supporting the conjecture that airlines price discriminate when the mix of purchasing passengers makes demand more elastic. Further decomposing our results, we find that the largest holiday discounts are offered for flights that are within one-week of departure (fares typically purchased by business travelers) and for flights booked during the Christmas (5.9% cheaper) and New Year's (4.0%-4.7% cheaper) holidays.

We also offer new evidence on the relationship between market structure and price discrimination. In oligopolistic markets, competition may either increase or decrease the extent of price discrimination when consumers differ both in their underlying willingness-to-pay and their degree of brand loyalty (as exists in the U.S. airline industry). On average, we find that holiday booking discounts are larger in highly competitive markets (2.2% cheaper) and lower in concentrated markets (1.5% cheaper).

We also exploit our data to examine peak-load pricing (a form of second-degree price discrimination) for traveling during national and federal holiday periods. Demand for these flights are expected to be high ex-ante as passengers travel home after visiting family or enjoying an extended holiday weekend. Consistent with the theory of peak-load pricing, we estimate travel premiums ranging from 41.6% to 82.0% during national holidays and from 4.6% to 35.0% during federal holidays. Examining the relationship between market structure and holiday peak-load pricing, we find that holiday travel premiums are generally larger in competitive markets. This finding is sensible considering that average fare levels are already high in concentrated markets, implying that monopolists and duopolists have less room to maneuver fares during high demand periods.

The analysis presented in this article offer some interesting avenues for further research. For example, future studies could extend the present analysis to other oligopolistic markets such as the cruise line, hotel, passenger railway, retail gasoline, and shipping markets. Moreover, although the analysis in this article focused on the U.S. airline industry, similar analyses could also be performed for the African, Asian, Australian, Canadian, European, and South American airline markets.

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Appendix A: List of markets included in our analysis

Table A1: List of directional airport-pairs included in our analysis

ABQ-LGA	DFW-LAS	JFK-MIA	MKE-SFO	RIC-LAX
ATL-BOS	DFW-LAX	JFK-PBI	MSP-LAS	SAN-OAK
ATL-FLL	DFW-LGA	JFK-SFO	MSP-MCO	SAN-SFO
ATL-LAS	DFW-MCO	LAS-LAX	MSP-PHX	SAN-SJC
ATL-LAX	DFW-ORD	LAX-ATL	MSP-RSW	SAN-SMF
ATL-LGA	DTW-FLL	LAX-BOS	OAK-BUR	SAT-BOS
ATL-MCO	DTW-LAS	LAX-DEN	OAK-LAS	SEA-LAS
BDL-PHX	DTW-MCO	LAX-DFW	OAK-LAX	SEA-LAX
BDL-SFO	DTW-RSW	LAX-EWR	OAK-SAN	SEA-PHX
BOS-ATL	EWR-FLL	LAX-JAX	OAK-SNA	SEA-SAN
BOS-DCA	EWR-IAH	LAX-JFK	ORD-BOS	SEA-SFO
BOS-FLL	EWR-LAX	LAX-LAS	ORD-DCA	SFO-BDL
BOS-LAX	EWR-MCO	LAX-MCO	ORD-DEN	SFO-BOS
BOS-MCO	EWR-MIA	LAX-OAK	ORD-DFW	SFO-EWR
BOS-MIA	EWR-ORD	LAX-ORD	ORD-FLL	SFO-JFK
BOS-ORD	EWR-PBI	LAX-SEA	ORD-LAS	SFO-LAS
BOS-RSW	EWR-RSW	LAX-SFO	ORD-LAX	SFO-LAX
BOS-SFO	EWR-SFO	LGA-ATL	ORD-LGA	SFO-ORD
BUR-OAK	FLL-EWR	LGA-FLL	ORD-MCO	SFO-SAN
BWI-FLL	FLL-JFK	LGA-MCO	ORD-MIA	SFO-SEA
BWI-LAS	FLL-LGA	LGA-MIA	ORD-PHX	SJC-SAN
BWI-MCO	HOU-DAL	LGA-ORD	ORD-SFO	SJC-SNA
CLT-LGA	IAH-EWR	MCO-EWR	PDX-FLL	SLC-MIA
CMH-SEA	IAH-LAS	MDW-DEN	PDX-LAS	SMF-BUR
DAL-HOU	JAX-LAX	MDW-FLL	PDX-LAX	SMF-SAN
DAL-LAS	JAX-PHX	MDW-LAS	PHL-FLL	SMF-SNA
DEN-LAS	JFK-FLL	MDW-LAX	PHL-MCO	SNA-MCO
DEN-LAX	JFK-LAS	MDW-MCO	PHL-SNA	SNA-SJC
DEN-MCO	JFK-LAX	MDW-PHX	PHX-DEN	
DEN-PHX	JFK-MCO	MIA-LGA	RIC-LAS	

Appendix B: Standard errors for coefficient estimates in Tables 2-7

Table B1: Standard errors for coefficient estimates in Table 2

	(1)	(2)	(3)	(4)	(5)
DaysToDeparture 1-2	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
DaysToDeparture 3-6	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
DaysToDeparture 7-13	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
DaysToDeparture 14-20	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
WeekendBook		(0.000)	(0.000)	(0.000)	(0.000)
HolidayBook		(0.001)	(0.001)		
HolidayBook * DaysToDeparture 1-2			(0.007)		
HolidayBook * DaysToDeparture 3-6			(0.006)		
HolidayBook * DaysToDeparture 7-13			(0.004)		
HolidayBook * DaysToDeparture 14-20			(0.003)		
Book on Labor Day				(0.004)	(0.004)
Book on Columbus Day				(0.003)	(0.003)
Book on Veteran's Day				(0.003)	(0.003)
Book on Thanksgiving				(0.003)	(0.003)
Book on Black Friday				(0.003)	(0.003)
Book on Cyber Monday				(0.003)	(0.003)
Book on Christmas Eve				(0.004)	(0.004)
Book on Christmas Day				(0.004)	(0.004)
Book on New Year's Eve				(0.003)	(0.003)
Book on New Year's Day				(0.003)	(0.003)
Book on M.L. King Day				(0.004)	(0.004)
Book on President's Day				(0.007)	(0.008)
LCC * Book on Labor Day					(0.009)
LCC * Book on Columbus Day					(0.005)
LCC * Book on Veteran's Day					(0.004)
LCC * Book on Thanksgiving					(0.005)
LCC * Book on Black Friday					(0.006)
LCC * Book on Cyber Monday					(0.006)
LCC * Book on Christmas Eve					(0.006)
LCC * Book on Christmas Day					(0.007)
LCC * Book on New Year's Eve					(0.005)
LCC * Book on New Year's Day					(0.005)
LCC * Book on M.L. King Day					(0.006)
LCC * Book on President's Day					(0.021)

Table B2: Standard errors for coefficient estimates in Table 3

	(1)	(2)	(3)
DaysToDeparture 1-2	(0.027)	(0.027)	(0.027)
DaysToDeparture 3-6	(0.037)	(0.037)	(0.038)
DaysToDeparture 7-13	(0.028)	(0.028)	(0.028)
DaysToDeparture 14-20	(0.009)	(0.009)	(0.009)
DaysToDeparture 1-2 * Southwest	(0.044)	(0.044)	(0.044)
DaysToDeparture 3-6 * Southwest	(0.048)	(0.048)	(0.048)
DaysToDeparture 7-13 * Southwest	(0.037)	(0.037)	(0.036)
DaysToDeparture 14-20 * Southwest	(0.013)	(0.013)	(0.013)
WeekendBook		(0.000)	(0.000)
HolidayBook		(0.001)	(0.002)
HolidayBook * Southwest		(0.002)	(0.002)
HolidayBook * DaysToDeparture 1-2			(0.010)
HolidayBook * DaysToDeparture 3-6			(0.009)
HolidayBook * DaysToDeparture 7-13			(0.005)
HolidayBook * DaysToDeparture 14-20			(0.004)
HolidayBook * DaysToDeparture 1-2 * Southwest			(0.015)
HolidayBook * DaysToDeparture 3-6 * Southwest			(0.012)
HolidayBook * DaysToDeparture 7-13 * Southwest			(0.007)
HolidayBook * DaysToDeparture 14-20 * Southwest			(0.005)

Table B3: Standard errors for coefficient estimates in Table 4

	(1)	(2)	(3)
DaysToDeparture 1-2	(0.023)	(0.023)	(0.023)
DaysToDeparture 3-6	(0.031)	(0.031)	(0.031)
DaysToDeparture 7-13	(0.024)	(0.024)	(0.024)
DaysToDeparture 14-20	(0.008)	(0.008)	(0.008)
DaysToDeparture 1-2 * Connect	(0.035)	(0.035)	(0.035)
DaysToDeparture 3-6 * Connect	(0.038)	(0.038)	(0.038)
DaysToDeparture 7-13 * Connect	(0.028)	(0.028)	(0.027)
DaysToDeparture 14-20 * Connect	(0.010)	(0.010)	(0.010)
WeekendBook		(0.000)	(0.000)
HolidayBook		(0.001)	(0.001)
HolidayBook * Connect		(0.002)	(0.003)
HolidayBook * DaysToDeparture 1-2			(0.009)
HolidayBook * DaysToDeparture 3-6			(0.008)
HolidayBook * DaysToDeparture 7-13			(0.005)
HolidayBook * DaysToDeparture 14-20			(0.003)
HolidayBook * DaysToDeparture 1-2 * Connect			(0.013)
HolidayBook * DaysToDeparture 3-6 * Connect			(0.010)
HolidayBook * DaysToDeparture 7-13 * Connect			(0.006)
HolidayBook * DaysToDeparture 14-20 * Connect			(0.004)

Table B4: Standard errors for coefficient estimates in Table 5

	(1) Conctr.	(2) Compet.	(3) Highly compet.	(4) Conctr.	(5) Compet	(6) Highly compet.
DaysToDeparture 1-2	(0.033)	(0.040)	(0.034)	(0.033)	(0.040)	(0.034)
DaysToDeparture 3-6	(0.044)	(0.064)	(0.043)	(0.043)	(0.064)	(0.043)
DaysToDeparture 7-13	(0.041)	(0.053)	(0.031)	(0.041)	(0.052)	(0.031)
DaysToDeparture 14-20	(0.017)	(0.015)	(0.012)	(0.016)	(0.015)	(0.012)
WeekendBook	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
HolidayBook	(0.002)	(0.002)	(0.002)	(0.004)	(0.003)	(0.002)
HolidayBook * DaysToDeparture 1-2				(0.018)	(0.017)	(0.014)
HolidayBook * DaysToDeparture 3-6				(0.019)	(0.016)	(0.012)
HolidayBook * DaysToDeparture 7-13				(0.014)	(0.010)	(0.007)
HolidayBook * DaysToDeparture 14-20				(0.010)	(0.006)	(0.004)

Table B5: Standard errors for coefficient estimates in Table 6

	(1) Concentrated	(2) Competitive	(3) Highly competitive
DaysToDeparture 1-2	(0.033)	(0.040)	(0.034)
DaysToDeparture 3-6	(0.044)	(0.064)	(0.043)
DaysToDeparture 7-13	(0.041)	(0.053)	(0.031)
DaysToDeparture 14-20	(0.017)	(0.015)	(0.012)
WeekendBook	(0.002)	(0.001)	(0.001)
Book on Labor Day	(0.020)	(0.014)	(0.007)
Book on Columbus Day	(0.015)	(0.006)	(0.004)
Book on Veteran's Day	(0.017)	(0.009)	(0.004)
Book on Thanksgiving	(0.007)	(0.006)	(0.005)
Book on Black Friday	(0.006)	(0.005)	(0.005)
Book on Cyber Monday	(0.005)	(0.006)	(0.004)
Book on Christmas Eve	(0.007)	(0.009)	(0.007)
Book on Christmas Day	(0.009)	(0.008)	(0.007)
Book on New Year's Eve	(0.006)	(0.007)	(0.006)
Book on New Year's Day	(0.006)	(0.007)	(0.006)
Book on M.L. King Day	(0.013)	(0.008)	(0.007)
Book on President's Day	(0.022)	(0.024)	(0.014)
LCC * Book on Labor Day	(0.025)	(0.023)	(0.016)
LCC * Book on Columbus Day	(0.017)	(0.015)	(0.007)
LCC * Book on Veteran's Day	(0.021)	(0.012)	(0.007)
LCC * Book on Thanksgiving	(0.011)	(0.010)	(0.009)
LCC * Book on Black Friday	(0.010)	(0.012)	(0.010)
LCC * Book on Cyber Monday	(0.023)	(0.010)	(0.008)
LCC * Book on Christmas Eve	(0.013)	(0.012)	(0.010)
LCC * Book on Christmas Day	(0.014)	(0.012)	(0.011)
LCC * Book on New Year's Eve	(0.010)	(0.009)	(0.008)
LCC * Book on New Year's Day	(0.012)	(0.010)	(0.009)
LCC * Book on M.L. King Day	(0.016)	(0.016)	(0.009)
LCC * Book on President's Day	(0.046)	(0.060)	(0.036)

Table B6: Standard errors for coefficient estimates in Table 7

	(1) All flights	(2) Nonstop flights	(3) Concentrated	(4) Competitive	(5) Highly competitive
DaysToDeparture 1-2	(0.022)	(0.023)	(0.033)	(0.041)	(0.034)
DaysToDeparture 3-6	(0.025)	(0.031)	(0.044)	(0.064)	(0.043)
DaysToDeparture 7-13	(0.019)	(0.024)	(0.041)	(0.053)	(0.031)
DaysToDeparture 14-20	(0.006)	(0.008)	(0.017)	(0.015)	(0.012)
WeekendBook	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)
HolidayBook	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
TravelNationalHoliday t-3	(0.017)	(0.022)	(0.049)	(0.042)	(0.030)
TravelNationalHoliday t-2	(0.018)	(0.024)	(0.048)	(0.045)	(0.033)
TravelNationalHoliday t-1	(0.016)	(0.021)	(0.043)	(0.039)	(0.029)
TravelNationalHoliday	(0.015)	(0.019)	(0.040)	(0.032)	(0.028)
TravelNationalHoliday t+1	(0.020)	(0.025)	(0.047)	(0.041)	(0.037)
TravelNationalHoliday t+2	(0.017)	(0.021)	(0.045)	(0.036)	(0.031)
TravelNationalHoliday t+3	(0.019)	(0.024)	(0.046)	(0.049)	(0.034)
TravelFederalHoliday t-3	(0.015)	(0.019)	(0.039)	(0.033)	(0.027)
TravelFederalHoliday t-2	(0.016)	(0.020)	(0.042)	(0.040)	(0.029)
TravelFederalHoliday t-1	(0.011)	(0.014)	(0.036)	(0.033)	(0.019)
TravelFederalHoliday	(0.010)	(0.013)	(0.022)	(0.026)	(0.019)
TravelFederalHoliday t+1	(0.006)	(0.008)	(0.016)	(0.016)	(0.011)
TravelFederalHoliday t+2	(0.005)	(0.007)	(0.013)	(0.013)	(0.008)
TravelFederalHoliday t+3	(0.007)	(0.009)	(0.023)	(0.018)	(0.011)