Loyalty rewards and redemption behavior: Identifying frequent flyer tickets in the U.S. airline industry

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Abstract

This paper develops a novel method to identify frequent flyer award (FFA) tickets in the Airline Origin and Destination Survey, making award redemption directly identifiable in one of the most widely used datasets in empirical industrial organization. Using this method, we demonstrate that FFAs are more likely to be redeemed for seasonal and leisure travel, and disproportionately originate from airports where the ticketing carrier is dominant. Other observable differences between FFAs and paid tickets have declined from 2005–2019, indicating a potential shift in how FFAs are valued and/or redeemed. Further, routes with larger shares of FFA passengers exhibit higher levels of price dispersion, suggesting that airline loyalty programs may enhance market power by increasing an airline's ability to price discriminate. Insights from airline reward behavior can help inform how loyalty programs across industries impact consumer welfare, market power, and firm behavior.

JEL Codes: L11, L13, L14, L93, M31, R40, R49

Keywords: Airlines, competition, loyalty rewards, frequent flyer tickets, product quality

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1 Introduction

Loyalty programs that reward consumers for repeat purchases are common in a variety of retail markets including airlines, car rentals, clothing, credit cards, hotels, restaurants, and supermarkets. By implementing loyalty programs, firms exercise a degree of market power over repeat customers by introducing a cost of switching to a competitor's product. These switching costs often include foregoing future rewards in addition to transaction costs associated with switching suppliers, learning to use new brands, and uncertainty about the quality of the competing product (Klemperer, 1995).

Although the typical consumer is a member of several different rewards programs, it is unclear whether these programs enhance or reduce competition in markets where they are present. For example, many have argued that loyalty programs are anticompetitive because switching costs generally raise prices, create barriers to entry, generate deadweight losses, facilitate tacit collusion, and reduce product variety (Banerjee and Summers, 1987; Behrens et al., 2024; Cairns and Galbraith, 1990; Fong and Liu, 2011; Kim et al., 2001; Klemperer, 1995). Others argue that loyalty programs are "business stealing devices" that enhance competition and increase total surplus (Caminal, 2012; Caminal and Claici, 2007; Caminal and Matutes, 1990).[1]

Despite the importance of determining whether loyalty programs increase consumer welfare, empirical evidence on the effects of these programs are limited. Data on program membership and redemption behavior are often proprietary, and thus, researchers have struggled to obtain appropriate data. However, there are some exceptions for the airline industry. Due to regulatory reporting requirements, airline data is often available to researchers. In a typical airline frequent flyer program (FFP), passengers accumulate miles or points on a specific carrier by purchasing flights or using that airline's co-branded credit cards. Once a passenger has accrued enough miles or points, they may redeem them for award travel, subject to availability and program rules. Many programs

[1] In addition, Basso et al. (2009) argue that within the airline industry, firms create frequent flyer programs to take advantage of the principal-agent problem between employers who pay for airline tickets and the employees who book them. In their theoretical model, they find that while these programs likely raise prices, airlines may end up worse off than if they had not created the programs due to intensified competition in the form of frequent flyer benefits.

also include tiered elite status levels that offer additional benefits such as upgrades, early boarding, or reduced fees.

Using geocoded data from a major European frequent flyer program (FFP), De Jong et al. (2019) find that national airlines enjoy a substantial loyalty advantage in their home country.[2] In a related paper, Behrens et al. (2024) demonstrate that airlines use FFP tier levels (e.g., Silver, Gold, Platinum) to create switching costs for high-frequency travelers. Furthermore, Lederman (2007) used airline mergers to instrument for enhancements to an airline's FFP and found that these enhancements are associated with increases in demand on routes that depart from an airline's hub airports (i.e., airports where the airline is dominant). In a follow-up paper, Lederman (2008) finds that FFPs enable airlines to charge higher fares on routes that depart from its hubs.

Nevertheless, many questions surrounding the economics of loyalty programs remain unexplored. For example, are consumers encouraged to redeem rewards on high or low quality products when the firm operating the loyalty program vertically differentiates its products? Do consumers disproportionately redeem rewards on high or low price products when multiple redemption options are available? How do loyalty programs affect price dispersion in differentiated product markets? In this paper, we shed light on these questions by developing a novel methodology to identify frequent flyer award tickets in the U.S. airline industry. This contribution enables us to present new empirical evidence on loyalty reward redemption behavior using publicly available data. In addition to providing insight into broader questions about the design and effects of loyalty programs generally, understanding frequent flyer redemption behavior is also essential for analyzing the U.S. airline industry as well. These loyalty programs are vital to airline profitability, with every major U.S. carrier reporting that revenue generated from their frequent flyer programs exceeded their net income in 2019.

Empirical questions concerning the economics of loyalty programs have been difficult to answer due to difficulties in identifying award redemptions in public and proprietary datasets. Our novel contribution outlines an approach to credibly identify frequent flyer awards in one of the most

[2]In particular, De Jong et al. (2019) find that foreign consumers earn about 60% less miles and are 70% less likely to be FFP members than domestic consumers.

widely used datasets in empirical industrial organization and transportation economics, the Department of Transportation's Airline Origin and Destination Survey (referred to as database DB1B). Released quarterly, the DB1B data are a 10% random sample of all airline tickets that originate in the United States on domestic carriers.[3] Over the past forty years, researchers relying on these data have provided empirical evidence on important questions surrounding competition policy and the functioning of oligopolistic markets. For example, the DB1B have been used to examine topics such as how incumbents respond to the threat of entry[4], the relationship between competition and price dispersion[5], how competition affects prices and profitability[6], the price effects of mergers[7], the price effects of granting antitrust immunity in international markets[8], the price effects of domestic alliances[9], how multimarket contact may facilitate tacit collusion[10], how capacity constraints affect prices[11], the revenue effects of product unbundling[12], and the competitive effects of common ownership[13], among others.[14]

Despite the breadth and influence of the existing literature based on the DB1B data, prior work has often removed frequent flyer award tickets from their analysis, often through sample restrictions on low-fare tickets. Almost all papers remove observations with fares below a $20 or $25 cutoff, assuming that these fares represent heavily discounted fares, frequent flyer award (FFA) tickets, or other non-commercial tickets.[15] This paper's initial contribution is to develop a

[3]The Department of Transportation relies on these data to determine air traffic patterns, air carrier market shares, and passenger flows.

[4]E.g., see Goolsbee and Syverson (2008), Gayle and Wu (2013), Gayle and Xie (2018), Morrison (2001), and Tan (2016).

[5]E.g., see Borenstein and Rose (1994), Gerardi and Shapiro (2009), Dai et al. (2014), Luttmann (2019), and Kim et al. (2023).

[6]E.g., see Berry and Jia (2010), Brueckner et al. (2013), and Kwoka et al. (2016).

[7]E.g., see Luo (2014), Carlton et al. (2017), Shen (2017), and Li et al. (2022).

[8]E.g., see Brueckner and Whalen (2000), Whalen (2007), Brueckner et al. (2011), Gayle and Thomas (2016), Calzaretta Jr et al. (2017), Brueckner and Singer (2019), and Gayle and Xie (2019).

[9]E.g., see Gayle (2013).

[10]E.g., see Ciliberto and Williams (2014), Ciliberto et al. (2019), and Kim et al. (2021).

[11]E.g., see Fukui (2019).

[12]E.g., see Brueckner et al. (2015) and He et al. (2022).

[13]E.g., see Azar et al. (2018).

[14]The DB1B data have also been used to investigate how the internet influences price dispersion (Orlov, 2011) and how government legislation affects fares (Luttmann and Nehiba, 2020; Snider and Williams, 2015), among others.

[15]For example, Severin Borenstein has graciously posted raw and summary versions of the 1979Q1-2016Q3 DB1A/DB1B data on NBER's website. The summary files at the airline-route-quarter level are generated after removing tickets with fares below $20 and fares above $9,998. These datasets are available at *http://data.nber.org/data/dot-*

method to identify frequent flyer award passengers in the DB1B, enabling researchers to recover a substantial and economically meaningful component of airline transactions that has previously been omitted. In doing so, our approach creates opportunities to revisit a wide range of questions previously addressed using the DB1B, such as how incumbents respond to entry, how competition affects price dispersion, the fare effects of mergers and alliances, and the role of network structure and capacity constraints, through a new lens.

To identify frequent flyer tickets in the DB1B data, we exploit a February 1, 2002 federal regulation that established the Passenger Fee, also known as the September 11 Security Fee. This fee is collected by all commercial air carriers at the time airfare is purchased, *including when passengers redeem frequent flyer awards*. Focusing on the lower-fare portion of the DB1B dataset, we find that applying a $20 cutoff removes approximately 7%-10% of observations (tickets). We then compare our identified FFA observations to the number of FFAs reported by airlines in their annual Form 10-K filings, finding that FFAs account for roughly 7%-8% of revenue passenger miles in a given year with some substantial variation across carriers.[16] Our identification method for these FFAs appears robust, as our observations appear correlated with reported airline values even when the Passenger Fee calculation is changed in July 2014. These results suggest that FFAs can be credibly identified in the DB1B, and that the prevailing $20 exclusion threshold may be refined. Specifically, a $12 cutoff may be more appropriate for post-2002 data if a researcher's goal is to exclude FFAs while retaining other heavily discounted low-fare commercial tickets. Alternatively, our approach enables researchers to retain and study FFA tickets directly, opening the door to new questions concerning how reward redemptions respond to mergers and codeshare agreements, the rollout of airline-branded credit cards, and loyalty program devaluations over time, all of which may have implications for better understanding market power, consumer behavior, and welfare.

Using the FFAs we identify from 2005 to 2019, our second contribution is to characterize

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[16]A revenue passenger mile is a standard industry metric that summarizes the number of miles flown by paying (revenue) passengers. For example, a revenue passenger mile is flown when a revenue passenger is transported one mile.

how the attributes of award tickets differ from paid tickets, both in levels and in trends over time, and how these patterns vary between legacy and low-cost carriers. Across both types of carriers, we find that FFAs are more likely than paid tickets to be redeemed for leisure-oriented travel. Additionally awards are disproportionately used on routes with high seasonal variation in demand and to destinations associated with discretionary travel, such as ski resorts or national parks. We also find that FFAs are more likely to originate at airports where the carrier has a dominant share, suggesting that passengers based at hub airports have more opportunities to accrue and redeem frequent flyer miles. This pattern is consistent with the extensive literature on the hub premium, which argues that dominant carriers can charge higher fares at their hub airports due in part to the value that frequent travelers assign to loyalty program benefits.[17]

While these patterns suggest that frequent flyer awards are used in systematically different ways than paid tickets, we also find evidence of significant convergence in other characteristics over time. In the mid-2000s, FFAs were typically associated with longer distances traveled, more flight segments, a lower likelihood of nonstop service, and higher average fare routes, particularly for low-cost carriers. Across both legacy and low-cost carriers, these differences narrowed steadily over the sample period, and by 2019, many observable distinctions between award and paid tickets are no longer statistically significant. This convergence is suggestive of a broader shift in how frequent flyer awards are used and valued, possibly reflecting supply-side industry changes such as the transition from distance-based to revenue-based loyalty programs and the growing monetization of airline miles through credit card partnerships, or demand-side preferences as consumers increasingly treat miles as a cash-like payment mechanism.

In our final contribution, we demonstrate that routes with higher shares of frequent flyer passengers have higher levels of price dispersion. The increase in price dispersion is driven by both higher prices at the 10th percentile of fares and larger price increases at the 90th percentile of fares.

[17]For more on the hub premium, see Borenstein (1989), Lederman (2007), Lederman (2008), Lee and Luengo-Prado (2005), Ciliberto and Williams (2010), Escobari (2011), and Bilotkach and Pai (2016). We note that this premium could also result from award tickets reducing the number of paid seats available on capacity-constrained airline-airport pairs. If FFAs displace low-fare paid tickets, or if low fares are systematically removed from the data, the average observed fare may be mechanically inflated.

These increases indicate that airlines may limit the availability of lower-priced tickets for paying customers when a higher number of frequent flyer passengers are present on a route. Furthermore, this suggests that airline loyalty programs may enhance market power by enabling airlines to more effectively engage in price discrimination.

The rest of this paper is organized as follows. Section 2 provides details on the size of the frequent flyer market. Section 3 describes the Department of Transportation (DOT) data used in the analysis and describes the method used to identify frequent flyer tickets. After identifying these award tickets, Section 4 outlines the descriptive analysis used to identify how FFAs differ from paid tickets and presents results from this ticket level analysis. Section 5 provides evidence on how FFAs affect price dispersion. Finally, Section 6 concludes.

2 Size of the frequent flyer market

To provide statistics on the size of the frequent flyer market, we compiled data from annual Form 10-K filings for each of the major U.S. airlines from 2005-2019.[18] Typical information reported on the Form 10-K include a company's organizational structure, risk factors, subsidiaries, and audited financial statements. Because frequent flyer programs are an important aspect of an airline's business strategy, many of the major airlines also report details on the size of their loyalty programs in these annual filings.

By airline and year, Table 1 reports the percentage of revenue passenger miles that are due to passengers traveling on frequent flyer awards. The numbers in Table 1 indicate that passengers traveling on frequent flyer awards account for a sizeable fraction of total passenger traffic. Depending on carrier, award passengers accounted for between 6.0% and 14.1% of revenue passenger miles in 2019. For the two low-cost carriers in the table, there is a clear trend of increasing award traffic over time. For Southwest, award passengers accounted for 6.6% of revenue passen-

[18]The Form 10-K reporting requirement was established as a result of the Securities and Exchange Act of 1934. For more information on the Form 10-K, see `https://www.sec.gov/fast-answers/answers-form10khtm.html`.

ger miles in 2005 compared to 14.1% in 2019. For JetBlue, award passengers accounted for just 2.0% of revenue passenger miles in 2005 compared to 6.0% in 2019. In contrast, the trend for the three major legacy carriers remained relatively constant from 2005-2019. On American, Delta, and United, passengers traveling on frequent flyer awards accounted for 7%-9% of revenue passenger miles in most years.

Table 1: Frequent Flyer Award Traffic
(% of revenue passenger miles)

Airline	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alaska (AS)	7.9	8.6	9.7	12.4	15.0	9.0	*	*	*	*	*	*	*	*	*
American (AA)	7.2	7.5	7.5	9.7	8.9	8.8	8.8	8.6	8.2	5.5	6.5	6.3	6.1	7.6	8.0
Continental (CO)	7.0	6.8	7.2	8.5	6.0	5.7	5.6	Acquired by United (UA)							
Delta (DL)	9.0	*	*	*	*	8.3	8.2	8.0	7.3	7.4	7.2	7.9	7.9	8.2	8.9
Hawaiian (HA)	*	*	*	6.0	5.0	6.0	5.7	5.2	4.8	5.3	5.0	5.0	5.0	6.0	6.0
JetBlue (B6)	2.0	2.0	3.0	4.0	3.7	3.0	2.0	3.0	3.0	3.0	4.0	4.0	5.0	5.0	6.0
Northwest (NW)	7.3	7.3	*	*	Acquired by Delta (DL)										
Southwest (WN)	6.6	6.4	6.2	6.4	7.7	7.9	8.6	9.0	9.5	11.0	12.0	12.7	13.8	13.8	14.1
United (UA)	7.4	8.1	8.0	9.1	8.3	7.5	8.2	7.1	7.7	7.1	7.5	7.7	7.5	7.1	7.2
U.S. Airways (US)	9.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.5	Merged with American (AA)					

Source: 2005-2019 Form 10-K filings for Alaska, American, Continental, Delta, Hawaiian, JetBlue, Northwest, Southwest, United, and U.S. Airways.

Notes: *Number not reported in Form 10-K filing. A revenue passenger mile is flown when a paying (revenue) passenger is transported one mile. AirTran (FL), Frontier (F9), Spirit (NK), and Virgin America (VX) are not included because they do not report the number of frequent flyer awards in their annual Form 10-K filings. Allegiant (G4) introduced their frequent flyer program in August 2023.

By airline and year, Table A1 reports the number of frequent flyer award tickets redeemed. Across all airlines, there is a clear increasing trend in the number of award tickets redeemed over time with number of award flights across reporting carriers, increasing from just over 18 million in 2005 to more than 50 million in 2019. This increasing trend is likely a result of a combination of factors including the introduction of airline branded credit cards that allowed reward program members to accrue frequent flyer miles, the completion of several mergers, and increasing travel demand over time.

Using data from 2019 Form 10-K filings, Table 2 compares airline revenue from loyalty programs to net income and liabilities accrued through their loyalty programs to the airline's long term debt. In 2019, each major domestic carrier reported frequent flyer program revenue that exceeded their net income. Additionally, carrier's liabilities from their frequent flyer programs are comparable to or exceed that of their long term debt.[19] Overall, the statistics presented in Tables 1 and 2 indicate that passengers traveling on frequent flyer awards represent a large and non-trivial fraction of total passenger traffic and play an important role in airline profitability.

Investors also immensely value loyalty programs given that several airlines collateralized the future cash flows of their frequent flyer programs to raise billions of dollars in loans during the Covid-19 pandemic. For example, United raised $6.8 billion in July 2020, Spirit $850 million in September 2020, Delta $9 billion in September 2020, and American $10 billion in March 2021.[20]

[19] Loyalty liabilities are not included in Form 10-K reports of Long Term Debt but are reported separately under other liabilities.

[20] For additional information on how loyalty programs helped save airlines during the Covid-19 pandemic, see https://hbr.org/2021/04/how-loyalty-programs-are-saving-airlines.

Table 2: Airline Loyalty Revenues and Liabilities in 2019
(millions of dollars)

Airline	Loyalty Revenue	Net Income	Loyalty Liabilities	Long Term Debt
Alaska (AS)	$1,169	$769	$1,990	$1,264
American (AA)	$5,540	$1,972	$8,615	$22,372
Delta (DL)	$4,862	$4,767	$6,728	$8,052
Hawaiian (HA)	$244	$224	$350	$547
JetBlue (B6)	$592	$569	$661	$1,990
Southwest (WN)	$3,787	$2,300	$3,385	$1,846
United (UA)	$4,350	$3,009	$5,276	$13,145

Source: 2019 Form 10-K filings for Alaska, American, Delta, Hawaiian, JetBlue, Southwest, and United.

3 Method for identifying frequent flyer tickets in the DB1B database

In order to identify airline frequent flyer awards, itinerary and price data (inclusive of all ticket taxes and fees) are taken from the U.S. Department of Transportation's DB1B database. Data from this survey are released quarterly and generated from a 10% random sample of all airline tickets that originate in the United States on U.S. based carriers. Information from this survey includes ticket characteristics such as the total fare, fareclass, origin and destination airports, operating and ticketing carriers, distance flown, number of route segments, connecting airports (if any), and an indicator specifying if the ticket is roundtrip.

To identify frequent flyer tickets in the DB1B data, we exploit a February 1, 2002 federal regulation that established the Passenger Fee, also known as the September 11 Security Fee.[21]

[21] The Passenger Fee was initially authorized under the Aviation and Transportation Security Act. For more information on this fee, see `https://www.tsa.gov/for-industry/security-fees`.

This fee is collected by all commercial air carriers at the time airfare is purchased, *including when passengers redeem frequent flyer awards*.[22] Airlines then remit these fees to the Transportation Security Administration (TSA). Between February 1, 2002 and July 20, 2014, the TSA imposed a security fee of $2.50 per flight segment for a maximum of $5.00 per one-way trip or $10.00 per roundtrip. On July 21, 2014, the Passenger Fee was changed to $5.60 per one-way trip and $11.20 per roundtrip (i.e., fees no longer applied on a flight segment basis). Table 3 summarizes this regulation and the amendment made on July 21, 2014.

Table 3: Passenger Fee Summary

		Fee for one-way trips			Fee for Roundtrips		
Legislation	Effective Fee Date	One segment	Two segments	Three or more	Two segments	Three segments	Four or more
Public Law 107–71	Feb. 1, 2002	$2.50	$5.00	$5.00	$5.00	$7.50	$10.00
Public Law 113–67/113–294	Jul. 21, 2014	$5.60	$5.60	$5.60	$11.20	$11.20	$11.20

Source: Federal Register Vol. 66, No. 250, Federal Register Vol. 79, No. 119, and Federal Register Vol. 80, No. 107. More information on the Passenger Fee is located at `https://www.tsa.gov/for-industry/security-fees`.
Notes: "The security service fee must be imposed on passengers who obtained the ticket for air transportation with a frequent flyer award, but may not be imposed on other nonrevenue passengers." Federal Register Vol. 79, No. 119.

Because passengers redeeming frequent flyer awards (FFAs) are required to pay the Passenger Fee, we identify FFAs in the DB1B by classifying tickets according to the fee structure in Table

[22] Specifically, the original legislation states that "Direct air carriers and foreign air carriers must collect the security service fees imposed on air transportation sold on or after February 1, 2002. *The security service fee imposed by this interim final rule applies to passengers using frequent flyer awards for air transportation, but is not applicable to other nonrevenue passengers.*" See Federal Register Vol. 66, No. 250 available at `https://www.govinfo.gov/content/pkg/FR-2001-12-31/pdf/01-32254.pdf`.

3. Prior to July 21, 2014, one segment trips with \$2.50 fares are identified as FFAs.[23] One-way trips with two or more segments and roundtrips with two segments are identified as FFAs if the fare charged was \$5. For roundtrips with three segments, tickets with \$7.50 fares are identified as FFAs.[24] For roundtrips with four or more segments, tickets with \$10 fares are identified as FFAs. After July 20, 2014, one-way trips with \$5.60 fares and roundtrips with \$11.20 fares are identified as FFAs.[25]

3.1 Applying identification methodology to DB1B

Figures 1, 2, and 3 illustrate our strategy for identifying FFAs. In Figure 1, the distribution of DB1B fares under \$20 in 2005, 2010, 2015, and 2018 are presented. In line with the Passenger Fees in effect prior to July 21, 2014, spikes in the distribution occur at \$2, \$5, \$7, and \$10 in 2005 and 2010. Reflecting the Passenger Fee change in 2014, spikes occur at \$5 and \$11 in 2015 and 2018. However, not all tickets with fares less than \$20 are FFAs. For example, the spikes observed at \$0 in Figure 1 reflect nonrevenue passengers such as airline employees and friends and family of airline employees flying standby. In addition, some fares under \$20 may represent actual paid fares (e.g., Allegiant's \$9 flight sales and Frontier's \$15 and \$19 flash sales).

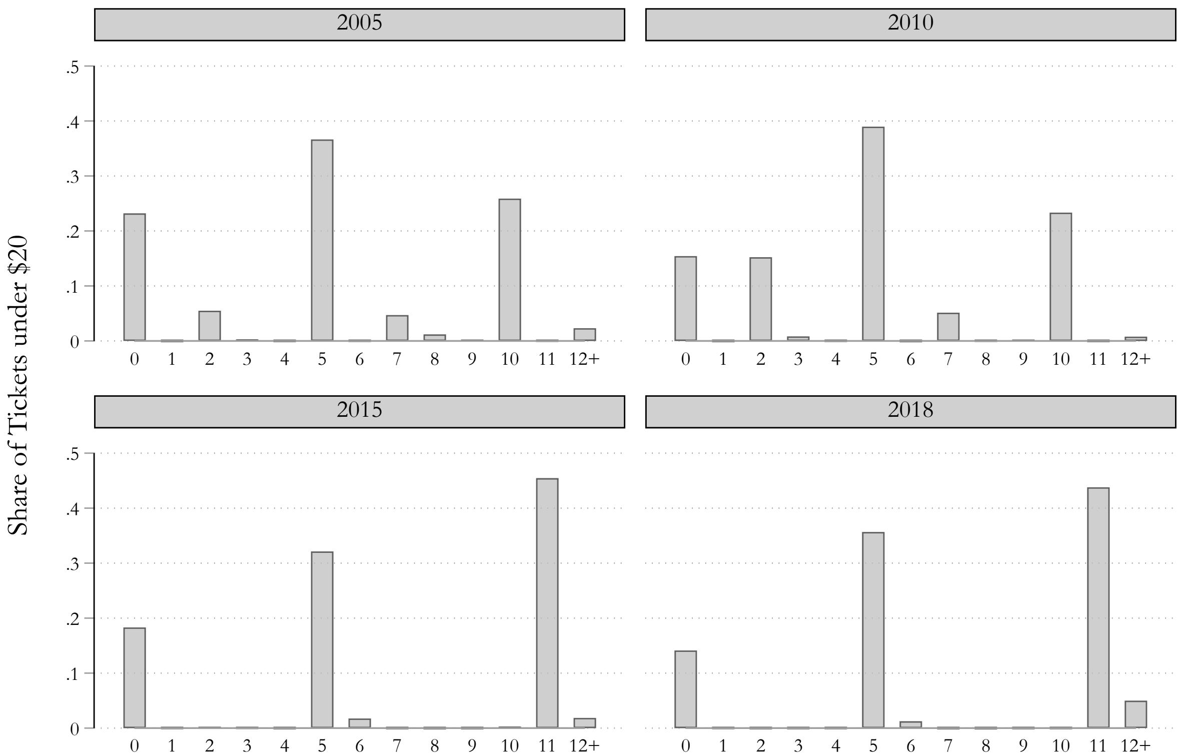
Figure 2 displays the distribution of DB1B fares under \$20 in 2013 (red bars) and 2015 (blue bars) for American (Panel A) and Delta (Panel B). The four charts in each panel correspond to the Passenger Fees charged to that itinerary under the 2013 fee regime. The chart titled "\$2.50" in each panel displays the distribution of fares under \$20 for one segment trips as these trips were subject to a Passenger Fee of \$2.50 in 2013. With the change in the Passenger Fee in 2014, these itineraries were then subject to a Passenger Fee of \$5.60 in 2015. Consistent with Table 3, spikes in the distribution of American and Delta's fares occur at \$2 in 2013 and \$5 in 2015 for these trips. Our approach classifies all one segment trips with \$2 fares before July 2014 and \$5 fares after July

[23] Since fares in the DB1B are expressed as whole numbers, one segment trips with fares of \$2 or \$3 are classified as FFAs prior to July 21, 2014.

[24] Three segment roundtrips with fares of \$7 or \$8 are identified as FFAs prior to July 21, 2014.

[25] One-way trips with fares of \$5 or \$6 are identified as FFAs after July 20, 2014. Similarly, roundtrips with \$11 or \$12 fares are identified as FFAs after July 20, 2014.

Figure 1: Distribution of DB1B Fares Under $20 in 2005, 2010, 2015, and 2018



Notes: Data are from DB1B files for 2005, 2010, 2015 and 2018 and limited to one-way itineraries with three or fewer segments and round trip itineraries with six or fewer segments. Bars represent the share of passengers with tickets under $20 that reported that exact itinerary fare. Appendix B discusses how Continental and United Airlines may be assigning passengers redeeming frequent flyer awards an itinerary fare of $0 in the DB1B database. United and Continental Airlines drive a substantial fraction of the $0 itinerary fares reported above.

2014 as FFAs. All other one segment trips are not identified as FFAs (e.g., one segment trips with $0 fares are not identified as FFAs).

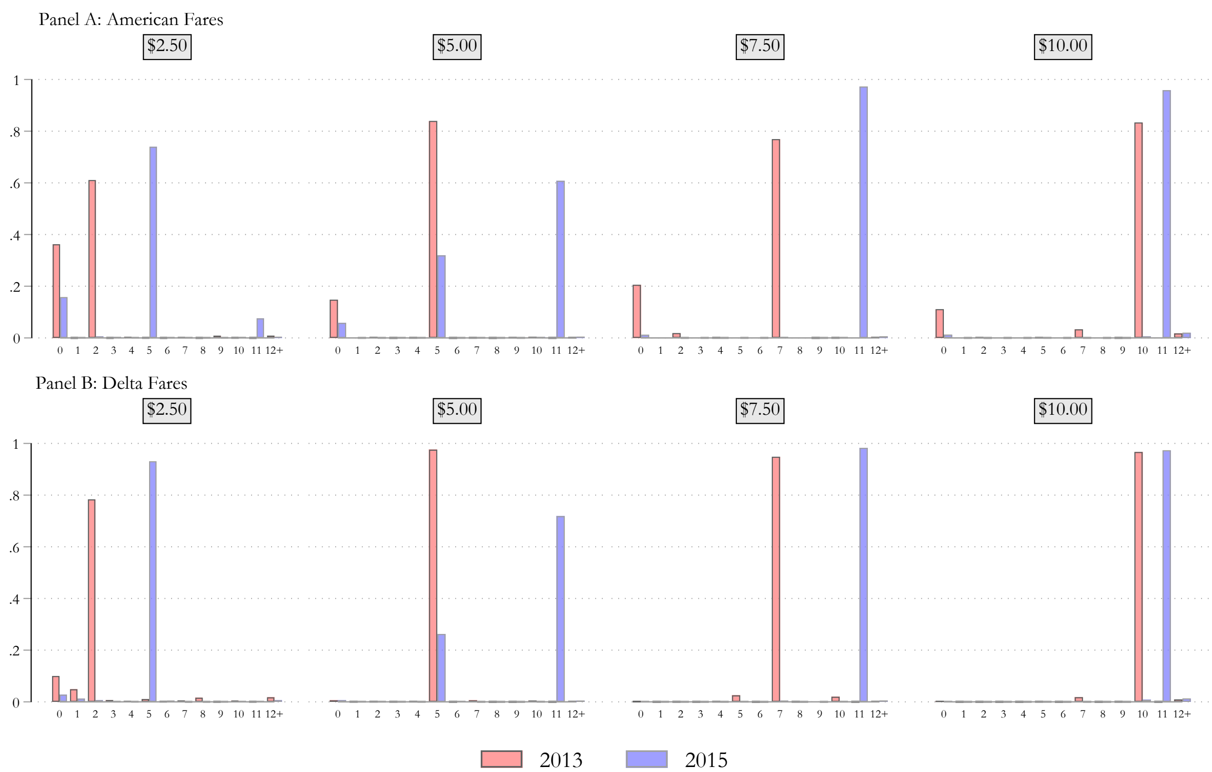
The "$5.00" charts in Figure 2 display the distribution of American (Panel A) and Delta's (Panel B) fares under $20 for multi-segment one-way trips and two segment roundtrips in 2013 and 2015. The Passenger Fee for one-way trips with multiple segments was $5 in 2013 and $5.60 in 2015 while the Passenger Fee for roundtrips with two segments was $5 in 2013 and $11.20 in 2015. Consistent with Table 3, fare spikes for these trips occur at $5 in 2013 (red bars) and at $5 and $11 in 2015 (blue bars). Accordingly, two segment trips with $5 fares before July 2014 and two segment trips with $5 (one-way trips) or $11 (roundtrips) fares after July 2014 are identified as FFAs. All other trips with two segments are not identified as FFAs.

The "$7.50" charts in Figure 2 display the distribution of American (Panel A) and Delta's (Panel B) fares under $20 for three segment roundtrips in 2013 and 2015. The Passenger Fee for roundtrips with three segments was $7.50 in 2013 and $11.20 in 2015. As expected, large spikes in the distribution of American and Delta's fares for three segment trips occur at $7 in 2013 (red bars) and $11 in 2015 (blue bars). In line with Table 3, we classify three segment one-way trips with $5 fares in addition to three segment roundtrips with $7 fares before July 2014 and $11 fares after July 2014 as FFAs. All other trips with three segments are not identified as FFAs.

The "$10.00" charts in Figure 2 display the distribution of American (Panel A) and Delta's (Panel B) fares under $20 for roundtrips with four or more segments in 2013 and 2015. The Passenger Fee for roundtrips with four or more segments was $10 in 2013 and $11.20 in 2015. As expected, large spikes in the distribution of American and Delta's fares for these trips occur at $10 in 2013 and $11 in 2015. In line with Table 3, roundtrips with four or more segments and $10 fares before July 2014 and $11 fares after July 2014 are classified as FFAs. All other trips with four or more segments are not identified as FFAs.

Figure 3 is analogous to Figure 2, except that the distribution of fares under $20 in 2013 (red bars) and 2015 (blue bars) are displayed for Southwest (Panel A) and JetBlue (Panel B). Consistent with Figure 2, fare spikes for one segment trips ("$2.50" charts) occur at $2 in 2013 and $5 in 2015,

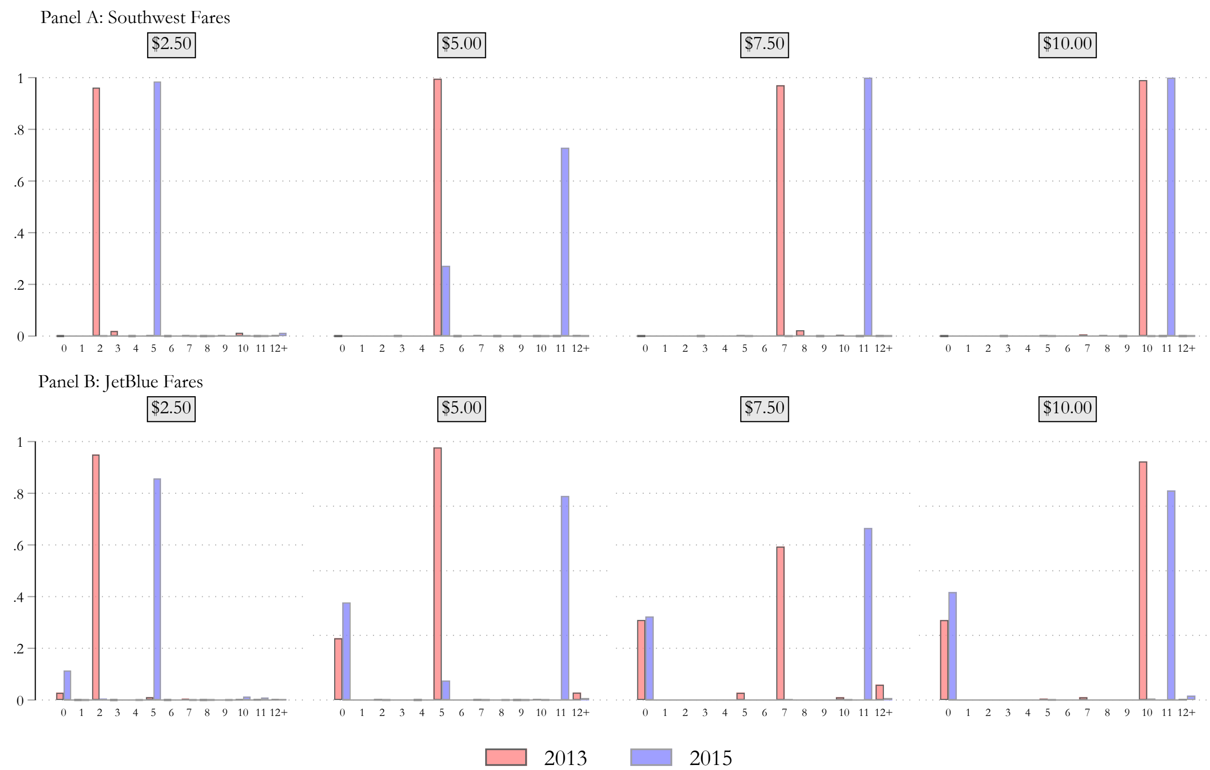
Figure 2: American and Delta Fares Under $20 by Expected Passenger Fee in 2013



Notes: Data are from DB1B files for 2013 and 2015 and limited to observations on American or Delta Flights. Bars represent the share of passengers with tickets under $20 and the expected Passenger Fee in 2013 that reported that exact itinerary fare. Passenger Fees of $2.50 expected for one segment one-way flights. Passenger Fees of $5.00 expected for two or three segment one-way flights or two segment roundtrip flights. Passenger Fees of $7.50 expected for roundtrip flights with one leg having two or three segments while the other leg has only one. Passenger Fees of $10.00 expected for roundtrip flights with both legs having two or three segments.

at $5 in 2013 and at $5 and $11 in 2015 for two segment trips ("$5.00" charts), at $7 in 2013 and $11 in 2015 for three segment trips ("$7.50" charts), and at $10 in 2013 and $11 in 2015 for trips with four or more segments ("$10.00" charts).

Figure 3: Southwest and JetBlue Fares Under $20 by Expected Passenger Fee in 2013



Notes: Data are from DB1B files for 2013 and 2015 and limited to observations on Southwest or JetBlue Flights. Bars represent the share of passengers with tickets under $20 and the expected Passenger fee in 2013 that reported that exact itinerary fare. Passenger fees of $2.50 expected for one segment one-way flights. Passenger fees of $5.00 expected for two or three segment one-way flights or two segment roundtrip flights. Passenger fees of $7.50 expected for roundtrip flights with one leg having two or three segments while the other leg has only one. Passenger fees of $10.00 expected for roundtrip flights with both legs having two or three segments.

3.2 Comparison to Airline Reported Values in Annual Form 10-K Filings

Table 4 compares the results from using this Passenger Fee method to identify FFAs with those reported in each airline's annual Form 10-K filings. Panel A of Table 4 is analogous to Table 1 except with revenue passenger mile calculations that are derived from our method of identifying FFAs in the DB1B data. Panel B gives the percentage point difference between Panel A and Table 1. Our method appears to identify similar proportions of FFA tickets, though there are some airline-specific over- and underestimates of awards. The observed differences between our estimate of FFAs as a percent of estimated revenue passenger miles and those reported in the Form 10-K filings are likely driven by differences in both the numerator (the number of FFAs we identify) and denominator (the total number of revenue passenger miles) of our calculation.[26]

It is likely that our method underestimates both components of the FFA share calculation. In particular, we do not observe either FFAs redeemed or revenue passenger miles for international travel, as our analysis relies on the publicly available domestic version of the DB1B database.[27] If an airline's customers redeem awards disproportionately on domestic routes, then not including international data may lead to our method overestimating that airline's percentage of revenue passenger miles from FFAs.[28] Airlines' with extensive codeshare operations or a reliance on codeshare partners could also lead to differences in our estimates of FFAs as a percent of estimated revenue passenger miles.[29] Importantly, we do not observe any sharp discontinuities in our estimates surrounding mid-2014, when the TSA fee structure, and our FFA identification methodology changed, strongly suggesting that our method identifies tickets that are very likely to be (or are highly correlated with) FFAs.[30]

[26] It is important to note that the numbers reported in Form 10-K filings appear to be rounded for some airlines (e.g., Alaska, Hawaiian, JetBlue, and U.S. Airways).

[27] Access to the international version of the DB1B database is restricted to U.S. citizens. To access these data, U.S. citizens must submit an application to the Office of Airline Information within the Bureau of Transportation Statistics.

[28] Similarly, any airline that has customers disproportionately redeeming FFAs for international trips would have a lower FFA share as a percentage of revenue passenger miles. For example, our large overestimates of FFA share for Hawaiian Airlines may be due to not including their long-haul international travel (26% of revenue in 2019). If Hawaiian has relatively few passengers that redeem FFAs for international trips, then excluding them would increase the denominator for the percentage revenue passenger miles calculation while not changing the numerator. For reference, Hawaiian reported 720,000 total frequent flyer awards in 2019 (see Table A1) while we identify approximately 512,000 frequent flyer awards for Hawaiian in 2019, providing further evidence that our method likely underestimates both components of the calculation.

[29] It is not abundantly clear how each airline would record codeshare flights in their Form 10-K revenue passenger mile calculations.

[30] For example, although our estimates for Southwest consistently exceed the reported FFA share, the trends align closely over time: our estimate grows from 9.2% in 2005 to 16.4% in 2019, compared to reported values of 6.6% to 14.1%. One explanation for the persistent gap may be Southwest's extensive use of "direct" flights, which are single-plane itineraries with intermediate stops that do not require passengers to deboard and change planes. In the

Table 4: Frequent Flyer Award Traffic From DB1B
(% of revenue passenger miles)

Panel A: Estimated Frequent Flyer Award Traffic From DB1B

Airline	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alaska (AS)	9.3	10.7	11.2	12.5	11.3	10.6	9.7	10.0	10.0	9.5	9.1	9.2	8.3	7.7	7.2
American (AA)	7.1	7.1	7.4	8.3	7.7	7.9	8.0	7.9	7.5	7.0	6.8	5.7	5.9	6.8	7.0
Continental (CO)†	—	—	—	—	—	—	—	Acquired by United (UA)							
Delta (DL)	4.8	4.2	8.8	7.0	8.2	7.7	7.9	7.8	7.6	7.6	7.4	8.2	8.2	8.2	8.2
Hawaiian (HA)	6.7	7.7	7.3	9.7	9.1	10.0	9.9	9.7	8.5	8.1	7.9	8.3	8.4	8.6	8.8
JetBlue (B6)	1.5	2.2	2.5	3.5	3.6	2.5	2.7	3.0	3.4	3.9	4.2	4.8	5.6	6.4	7.2
Northwest (NW)	6.2	6.3	6.4	6.4	Acquired by Delta (DL)										
Southwest (WN)	9.2	8.6	8.9	9.2	8.8	8.9	9.8	10.8	11.4	12.4	12.7	13.6	14.9	15.5	16.4
United (UA)‡	8.5	8.3	8.7	10.1	9.2	8.9	8.9	—	—	—	—	—	—	—	—
U.S. Airways (US)	5.3	2.5	3.5	3.7	3.2	4.4	4.3	4.0	4.1	Acquired by American (AA)					

Panel B: Difference in Frequent Flyer Award Traffic From DB1B Compared to Reported Numbers from 10-K Filings (Table 1)

Airline	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alaska (AS)	1.4	2.1	1.5	0.1	−3.7	1.6	*	*	*	*	*	*	*	*	*
American (AA)	−0.1	−0.4	−0.1	−1.4	−1.2	−0.9	−0.8	−0.7	−0.7	1.5	0.3	−0.6	−0.2	−0.8	−1.0
Continental (CO)†	—	—	—	—	—	—	—	Acquired by United (UA)							
Delta (DL)	−4.2	*	*	*	*	−0.6	−0.3	−0.2	0.3	0.2	0.2	0.3	0.3	0.0	−0.7
Hawaiian (HA)	*	*	*	3.7	4.1	4.0	4.2	4.5	3.7	2.8	2.9	3.3	3.4	2.6	2.8
JetBlue (B6)	−0.5	0.2	−0.5	−0.5	−0.1	−0.5	0.7	0.0	0.4	0.9	0.2	0.8	0.6	1.4	1.2
Northwest (NW)	−1.4	−1.3	*	*	Acquired by Delta (DL)										
Southwest (WN)	2.6	2.2	2.7	2.8	1.1	1.0	1.2	1.8	1.9	1.4	0.7	0.9	1.1	1.7	2.3
United (UA)‡	1.1	0.2	0.7	1.0	0.9	1.4	0.7	—	—	—	—	—	—	—	—
U.S. Airways (US)	−3.8	−1.5	−0.5	−0.3	−0.8	0.4	0.3	0.0	0.6	Merged with American (AA)					

Source: 2005-2019 DB1B and 2005-2019 Form 10-K filings for Alaska, American, Continental, Delta, Hawaiian, JetBlue, Northwest, Southwest, United, and U.S. Airways.

Notes: *Number not reported in Form 10-K filing. —Number not calculated in DB1B. A revenue passenger mile is flown when a paying (revenue) passenger is transported one mile. † Continental appears to report FFA tickets in DB1B with an itinerary fare of zero. ‡ United also reports FFA tickets with an itinerary fare of zero after their merger with Continental (2012-2019). See Appendix B for a more detailed discussion.

DB1B, these itineraries appear as single flight segments with the reported mileage as the distance between endpoints, omitting miles associated with any stopovers. This leads to systematic underreporting of revenue passenger miles in our estimates. If those "direct" flight tickets are less likely to be purchased by consumers redeeming FFAs, then this behavior would result in overestimates of Southwest's reported FFA share.

3.3 Potential Misclassifications

There are a few potential misclassification risks that warrant further discussion. We discuss how our method of using the Passenger Fee to identify FFAs is affected by international redemptions and close-in booking fees (Section 3.3.1), hybrid redemptions (Section 3.3.2), and redemptions that occur after a loyalty member purchases additional frequent flyer miles (Section 3.3.3).

3.3.1 International Redemptions and Close-In Booking Fees

For researchers with access to international DB1B data, the Passenger Fee can also be used to identify FFAs for international trips that are ticketed and operated by a U.S. carrier. For example, the authors of this study have previously redeemed Delta SkyMiles and United MileagePlus miles for one-way and roundtrip international travel where the prices paid were the required $5.60 and $11.20 passenger fees, respectively. However, there are a few caveats worth mentioning.

Foremost, when redeeming frequent flyer miles on an alliance partner (e.g., redeeming Delta SkyMiles for an award flight that is operated by Air France), the U.S. carrier may pass on a fuel surcharge (also known as a carrier-imposed surcharge) that increases the cost of the reward ticket above the Passenger Fee. American, Delta, and United generally do not impose fuel surcharges on their own reward flights but may implement them on partner awards. Even if a fuel surcharge applies, these surcharges are considered ancillary revenues (similar to baggage and seat selection fees) and should not be reflected in the fare that appears in the DB1B.[31] Hence, the Passenger Fee can be used to identify international FFAs with fuel surcharges that are ticketed by a U.S. carrier in many cases.

Second, redeeming frequent flyer miles on an alliance partner may also result in the U.S. carrier passing on taxes imposed by foreign governments and airport authorities. Since fares reported in the DB1B are inclusive of taxes and airport facility charges, partner awards with additional taxes that are passed on would have fares exceeding the Passenger Fee and would not be identified using

[31] Ancillary fees such as baggage fees, seat assignment fees, rebooking fees, and cancellation fees are reported by U.S. carriers to the Bureau of Transportation Statistics using Schedule P-1.2 of Form 41.

our method.

Third, American and United used to charge their award program members a "close-in booking fee" to redeem frequent flyer miles for travel very close to the date of departure. These close-in booking fees were eliminated by United on November 15, 2019 and American on January 15, 2020.[32] While the price paid by the passenger for the award ticket would be greater than the Passenger Fee, "close-in" booking fees are treated as ancillary revenues and should not be reflected in the fare that appears in the DB1B. As a result, the Passenger Fee can still be used to identify domestic and international FFAs where "close-in" booking fees apply.

3.3.2 Hybrid Redemptions

Several airlines have introduced "hybrid" redemption options where loyalty program members are allowed to pay with frequent flyer miles or use a combination of frequent flyer miles and cash to purchase tickets. In the U.S., JetBlue introduced its "Cash + Points" option on June 23rd, 2020 while United introduced its "Money + Miles" option on August 25th, 2021.[33]

In the case of "pay with miles", loyalty program members are allowed to partially or fully offset the cost of a ticket by redeeming frequent flyer miles at a fixed rate. For example, Delta SkyMiles members with a co-branded American Express credit card are currently able to redeem SkyMiles at a rate of 1 cent per mile in increments of 5,000 miles. In other words, 20,000 SkyMiles can be redeemed to purchase a $200 ticket or reduce the price of a more expensive ticket by $200.

"Miles plus cash" is similar to "pay with miles", except that loyalty program members are only able to partially (not fully) offset the cost of a ticket by redeeming frequent flyer miles for a discount. For instance, United MileagePlus members are able to use a combination of MileagePlus miles and cash to pay for a ticket by utilizing United's "Money + Miles" option.

In the "pay with miles" and "miles plus cash" cases, both types of hybrid redemptions would

[32] For more information on the elimination of these "close-in" booking fees, see https://thepointsguy.com/news/united-pulling-award-chart/ and https://thepointsguy.com/news/aa-eliminates-close-in-booking-fee/.

[33] See https://thepointsguy.com/news/jetblue-cash-and-points/ and https://pointspanda.com/blog/united-adds-money-and-miles-options/.

not be identified as a FFAs using the Passenger Fee approach since the fare recorded in the DB1B database would be the full cash price of the ticket. It is also not clear if airlines offering hybrid redemptions record them as FFAs in their annual filings.

3.3.3 Redemptions After Purchasing Frequent Flyer Miles

Most U.S. airlines provide loyalty members with the option to purchase additional frequent flyer miles when they do not have enough miles in their account to fully cover the cost of a reward ticket. This type of "hybrid" redemption is identified as a FFA using the Passenger Fee approach because the fare recorded in the DB1B database would be the $5.60 Passenger Fee for a one-way ticket or the $11.20 Passenger Fee for a roundtrip ticket.

4 Characteristics of frequent flyer tickets

Using the frequent flyer awards we identify, the goal of our descriptive analysis is to determine how the characteristics of frequent flyer awards differ from paid tickets. In Section 4.1, we outline the fixed effects model used to examine how FFAs differ from paid tickets for both legacy and low-cost carriers. In Section 4.2, we present results for ticket-level characteristics. In Section 4.3, we present results for market-level characteristics. Finally, Section 4.4 briefly highlights the major takeaways from the descriptive analysis.

4.1 Descriptive analysis regression model

To determine how the characteristics of frequent flyer tickets differ from paid tickets, we estimate equation (1) below,

$$y_{ijktn} = \beta_0 + \beta_1 \cdot \text{FrequentFlyer}_n + \beta_2 \cdot \text{FrequentFlyer}_n \cdot \text{LCC}_k + \beta_3 \cdot \text{LCC}_k + \beta_4 \cdot \text{Roundtrip}_n + \gamma_{ki} + \delta_{kj} + \theta_t + \epsilon_{ijktn} \quad (1),$$

where y_{ijktn} is the dependent variable measured at the origin i, destination j, ticketing carrier k, quarter t, and ticket n, level. γ is an airline-origin fixed effect and δ an airline-destination fixed effect. These fixed effects control for the airline's level of dominance at the origin and destination airports. θ_t is a quarter-of-year fixed effect that controls for seasonality in our dependent variables. Dependent variables are (i) one-way distance traveled (including stopovers if any) (ii) the number of flight segments on the itinerary, (iii) indicator specifying if the ticket is nonstop, (iv) the maximum Seasonal Variation in Demand Index (SVID)[34] of the origin airport i and destination airport j, (v) the average paid fare[35] for travel between origin airport i and destination airport j on ticketing carrier k in quarter t, (vi) the Herfindahl-Hirschman Index (HHI) for travel between origin airport i and destination airport j in quarter t, (vii) a measure of the share of passengers on carrier k for the origin airport i, and (viii) a measure of the share of passengers on carrier k for the destination airport j.

Roundtrip is an indicator that equals one for roundtrip tickets and zero for one-way tickets. Following the carrier classifications in Shrago (2024), LCC is an indicator that equals one if the ticketing carrier is a low-cost carrier (LCC) or an ultra low-cost carrier (ULCC) and zero if the ticketing carrier is a legacy carrier. The LCCs and ULCCs included in our analysis are AirTran, Alaska, Allegiant, Hawaiian, JetBlue, Virgin America, Southwest, Frontier, Spirit, and Sun Country. The legacy carriers are American, Continental, Delta, Northwest, United, and US Airways.

The coefficients of interest in equation (1) are β_1 and β_2, as these coefficients measure how frequent flyer award tickets differ from paid tickets with respect to the dependent variables. In particular, β_1 measures how FFAs differ from paid tickets for legacy carriers while $\beta_1+\beta_2$ measures how FFAs differ from paid tickets for LCCs and ULCCs.

Because equation (1) is estimated using ordinary least squares (OLS), β_1 and β_2 represent correlations and should not be interpreted in a causal manner. For example, even after conditioning on the included airline-origin, airline-destination, and quarter-of-year fixed effects, there may exist some unobserved factor that is correlated with both the dependent variable and the redemption of

[34]Following Appendix A of Li et al. (2022), SVID is calculated using monthly T100 data on passenger traffic as $\frac{\sum_{m=1,\ldots,M=12}(\frac{100*Traffic_{a,m}}{Traffic_a}-100)^2}{1000}$ where a refers to the airport. Large values of SVID indicate airports with considerable seasonality in passenger traffic.

[35]"Paid fares" are those not purchased with frequent flyer miles.

frequent flyer awards. If such an unobserved factor exists, then the coefficients on the frequent flyer variables should not be interpreted causally.

During our fifteen year sample period, several airlines merged with other carriers, changed the structure of their frequent flyer programs, and introduced airline branded credit cards that enabled frequent flyer program members to accrue reward miles outside of flying. To allow the estimated effects to differ over time, equation (1) is estimated separately for each year across our sample period. All regressions are weighted by the number of passengers and standard errors are two-way clustered at the airport-pair and airline level.[36]

4.2 Descriptive analysis results for ticket characteristics

Figure 4 displays the yearly coefficients on $FrequentFlyer$ when distance flown, number of flight segments, a nonstop trip indicator, and the maximum value of the Seasonal Variation In Demand (SVID) measure are the dependent variables in equation (1). The red lines in the figure display $FrequentFlyer$ coefficients for legacy carriers while the blue lines display $FrequentFlyer$ coefficients for LCCs and ULCCs. The bars stemming from the yearly coefficients indicate the 95% confidence interval.

As demonstrated in panel (a), passengers redeeming frequent flyer awards (FFAs) on both legacy and LCCs traveled substantially more miles than passengers traveling on paid tickets in 2005. In the early years of our data, LCC FFAs had larger differences compared to paid tickets than legacy carriers. For both types of carriers, this difference has steadily declined over time, with the difference for LCCs seeing a sharper decline. By 2019, the average distance flown on FFAs for both types of carriers was only around 50 miles more than the distance flown on non-FFAs.

Panel (b) of Figure 4 displays the coefficients on $FrequentFlyer$ when the number of flight segments is the dependent variable. In 2005, FFAs on both legacy and LCCs had more flight segments than non-FFAs. Similar to the miles flown panel, LCC FFAs had larger differences compared to paid tickets than legacy carriers. This difference has also steadily declined across

[36]Each ticket in the DB1B data contains a passenger count.

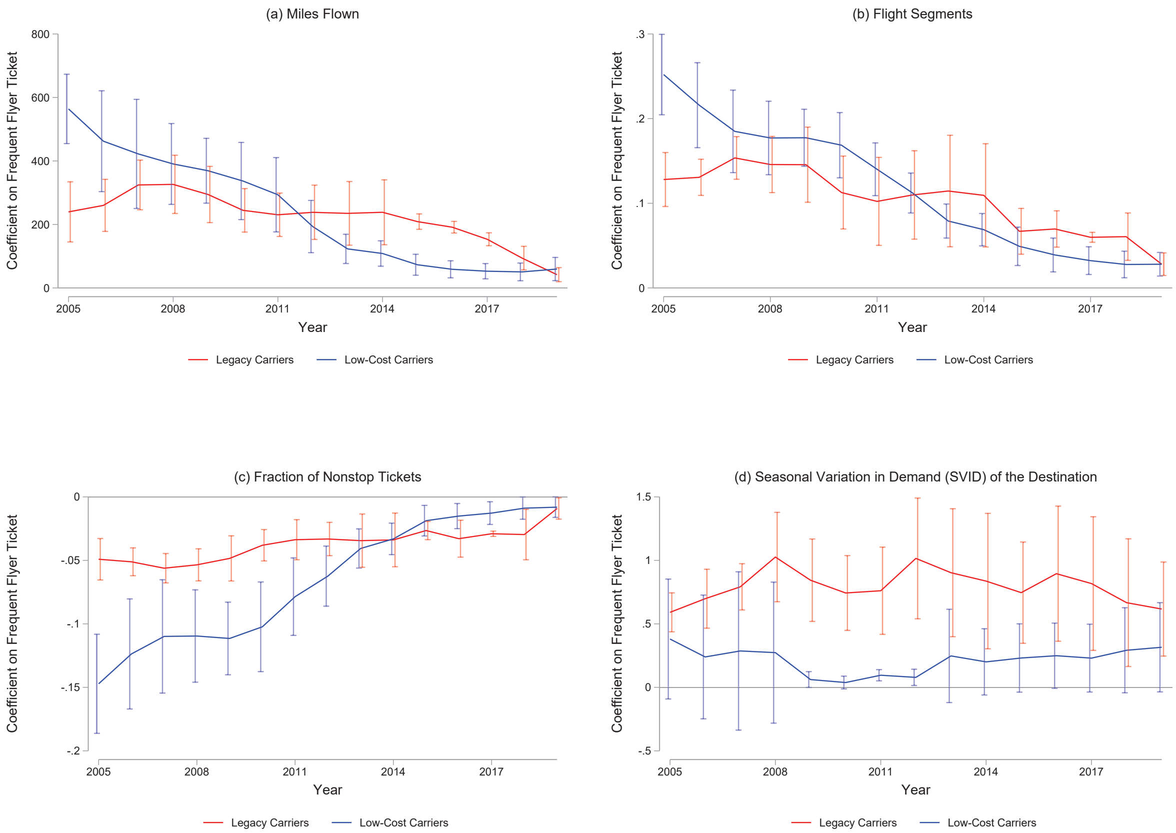
both carrier types over time. By 2019, FFAs across both legacy and LCCs involved an average of only 0.03 more flight segments.

Panel (c) of Figure 4 displays the coefficients on $FrequentFlyer$ when the nonstop trip indicator is the dependent variable. In 2005, FFAs for both types of carriers were more likely to involve connecting flights, but the difference was substantially larger for LCCs. Since nonstop flights are of higher quality than connecting flights, this finding—along with the increase in flight segments found in panel (b)–suggests that FFAs are redeemed on lower quality flights. However, this difference has also steadily declined over time for both types of carriers. By 2019, FFAs were only 1% more likely to involve connecting flights than paid fares.

Panel (d) of Figure 4 displays $FrequentFlyer$ coefficients when the maximum value of the Seasonal Variation In Demand (SVID) measure between the origin and destination airports is the dependent variable. High values of SVID indicate airports with substantial seasonal variation in demand (e.g., ski destinations such as Aspen (ASE), Eagle County (EGE), Jackson Hole (JAC), and Telluride (MTJ) where demand spikes during the winter). As demonstrated in panel (d), FFAs are disproportionately redeemed on more seasonal routes for legacy carriers and this difference has remained relatively constant across the time period. For LCCs, the $FrequentFlyer$ coefficient estimates are positive, but smaller than those observed for legacy carriers and often not statistically significantly different from zero.

To further illustrate that FFAs are disproportionately redeemed on seasonal routes to leisure destinations, Figure 5 displays Delta's route segments with large shares of frequent flyer passengers ($\geq 15\%$) in the first (January-March) and third quarters (July-September) of 2016. In the first quarter of 2016, these segments include routes from Delta's hubs in Atlanta (ATL), Los Angeles (LAX), Minneapolis (MSP), and New York City (JFK) to winter vacation destinations such as Honolulu (HNL), Maui (OGG), Kauai (LIH), and Kona (KOA) in Hawaii in addition to ski destinations such as Aspen (ASE), Eagle County (EGE), Gunnison (GUC), and Telluride (MTJ) in Colorado (see panel (a)). In the third quarter of 2016, these segments shifted further north from ski destinations in Colorado to summer vacation destinations near Glacier, Grand Teton, and Yellowstone

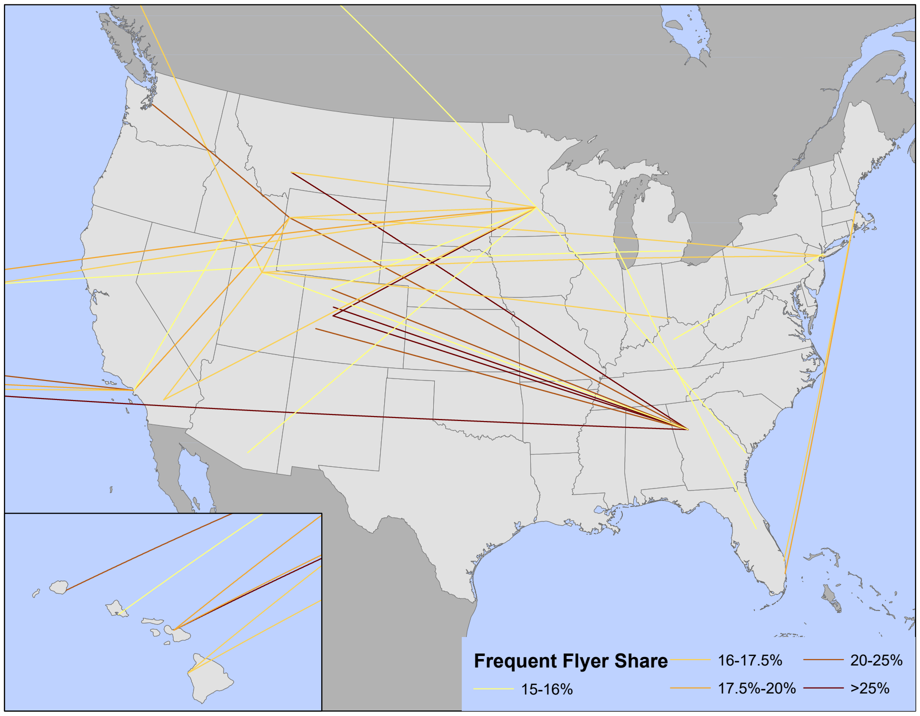
Figure 4: Difference in Ticket Characteristics of Frequent Flyer Awards on Legacy and Low-Cost Carriers



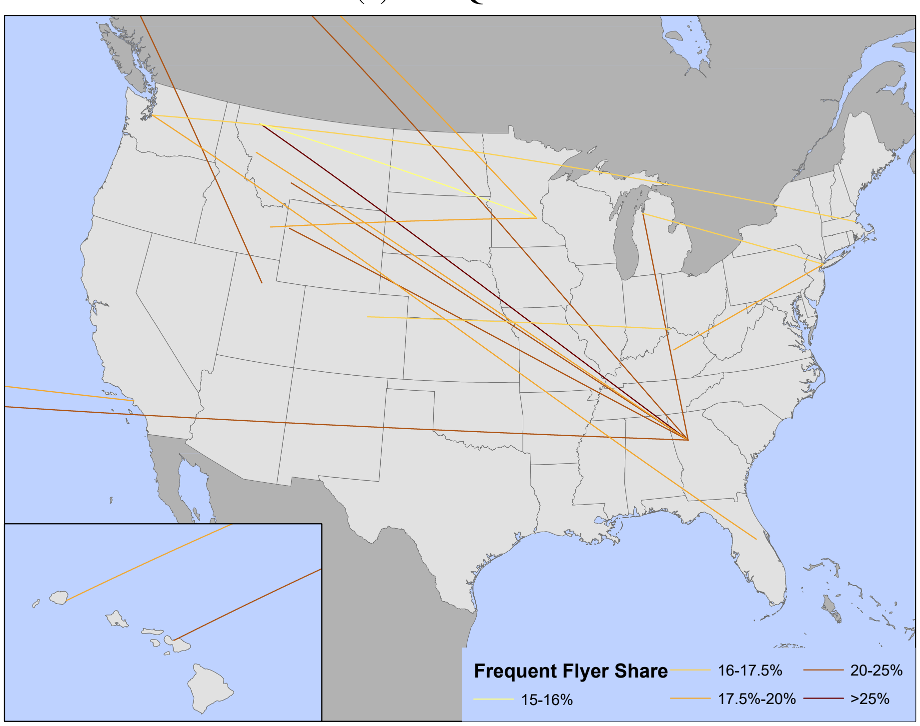
Notes: Charts display the yearly coefficients on $FrequentFlyer$ for regressions with the respective dependent variable for each panel. Regressions in panels (a), (b), and (c) include roundtrip status, quarter-of-year, airline-origin, and airline-destination fixed effects. The regressions in panel (d) include roundtrip status and quarter-of-year fixed effects. The red lines in the figure display $FrequentFlyer$ coefficients for legacy carriers while the blue lines display the linear combination of $FrequentFlyer$ coefficients for LCCs and ULCCs. The bars stemming from the yearly coefficients indicates the 95% confidence interval. Data are from the DB1B (2005-2019) and limited to one-way tickets with three or fewer segments and roundtrip tickets with six or fewer segments.

Figure 5: Delta Routes with Large Shares of Frequent Flyer Passengers in 2016

(a) 2016 Quarter 1



(b) 2016 Quarter 3



Notes: Data are from the DB1B and limited to one-way tickets with three or fewer segments and roundtrip tickets with six or fewer segments on Delta flights. Only segments with more than 15% of Delta passengers in that quarter identified as traveling on FFAs on routes with at least 500 passengers are included.

National Parks in Montana and Wyoming (see panel (b)). For example, these third quarter segments include routes from Delta's largest hub in Atlanta (ATL) to Bozeman Yellowstone (BZN), Glacier Park (FCA), Jackson Hole (JAC), and Missoula (MSO).

4.3 Descriptive analysis results for market characteristics

Figure 6 displays the yearly coefficients on $FrequentFlyer$ when the average paid fare, HHI, origin carrier share, and destination carrier share are the dependent variables in equation (1). Consistent with Figure 4, the red lines in the figure display $FrequentFlyer$ coefficients for legacy carriers while the blue lines display $FrequentFlyer$ coefficients for LCCs and ULCCs.

Panel (a) of Figure 6 displays $FrequentFlyer$ coefficients when the average paid fare is the dependent variable. For legacy carriers, FFAs and non-FFAs are not statistically different from each other in terms of the average fare on routes where FFAs are redeemed. Conversely, for LCCs, FFAs are redeemed on higher fare routes, with those differences declining over the sample period.

Panel (b) of Figure 6 displays $FrequentFlyer$ coefficients when HHI, a measure of market concentration, is the dependent variable.[37] Relative to non-FFAs, FFAs were reedemed on slighly less concentrated routes for legacy carriers. For LCCs, FFAs were redeemed on substantially less concentrated (i.e., more competitive) routes in the early years of our analysis, but this difference has sharply declined over time.

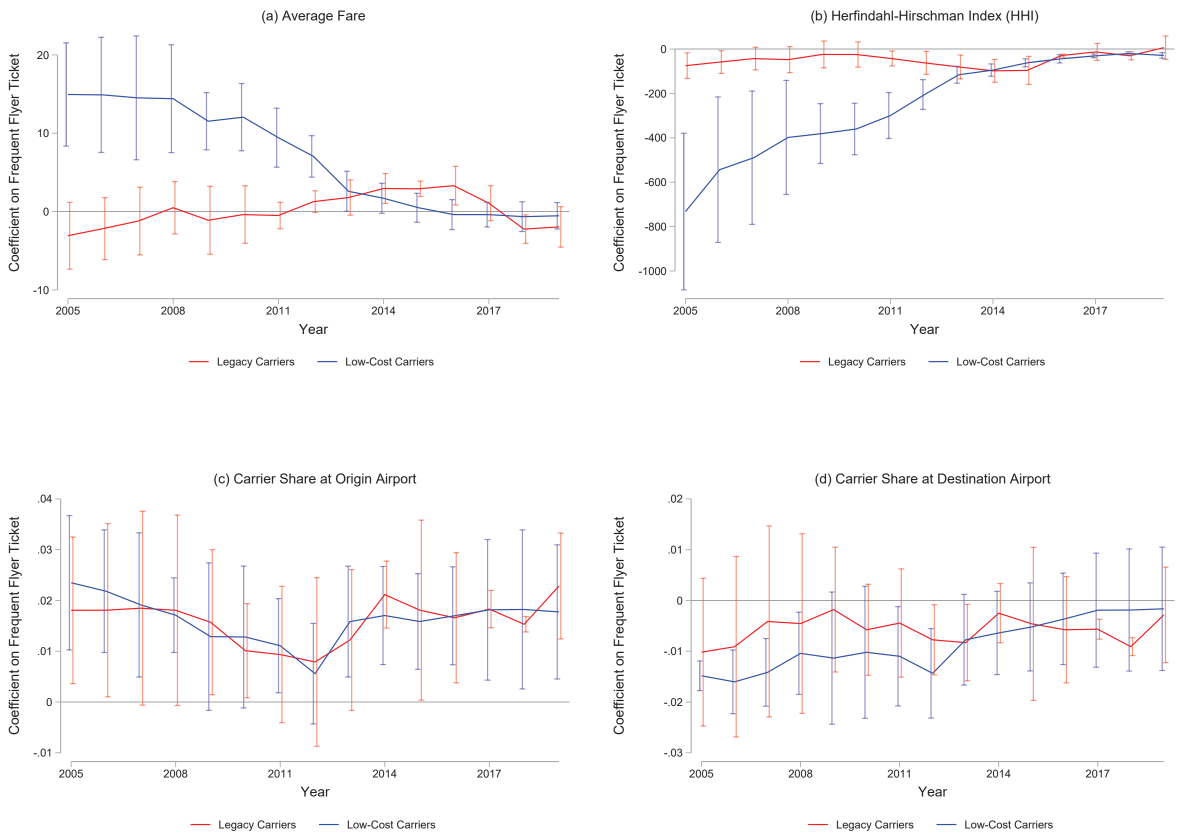
Panel (c) of Figure 6 displays $FrequentFlyer$ coefficients when the carrier share at the origin airport is the dependent variable. This specification suggests that FFAs for both legacy and LCCs are more likely to originate at airports with higher own-carrier shares (e.g., hub airports) where it may be easier for consumers to accrue frequent flyer miles.

Panel (d) of Figure 6 displays $FrequentFlyer$ coefficients when the carrier share at the destination airport is the dependent variable. This specification provides further suggestive evidence that FFAs might be disproportionately used to travel to destinations with lower own-carrier shares

[37] We also estimated a version where the number of nonstop competitors in the market was the dependent variable. Results from this robustness check are consistent with the HHI results.

which may reflect more leisure or seasonal destinations.

Figure 6: Difference in Market Characteristics of Frequent Flyer Award Tickets on Legacy and Low-Cost Carriers



Notes: Charts display the yearly coefficients on $FrequentFlyer$ for regressions with the respective dependent variable for each panel. Regressions in panels (a) and (b) include roundtrip status, quarter-of-year, airline-origin, and airline-destination fixed effects. The regressions in panels (c) and (d) include roundtrip status, quarter-of-year, and airline-origin or airline-destination fixed effects. The blue lines in the figure display $FrequentFlyer$ coefficients for legacy carriers while the red lines display the linear combination of $FrequentFlyer$ coefficients for LCCs and ULCCs. The bars stemming from the yearly coefficients indicates the 95% confidence interval. Data are from the DB1B (2005-2019) and limited to one-way tickets with three or fewer segments and roundtrip tickets with six or fewer segments.

4.4 Summary of descriptive analysis results

Taken together, the results depicted in Figures 4–6 provide insight into how frequent flyer award tickets differ from paid fares, for both legacy and LCCs, and how those differences have evolved from 2005 to 2019. Over this period, the gap in observable trip characteristics between award and paid tickets narrowed considerably for both carrier types. This convergence is suggestive of a broader shift in how frequent flyer awards are used and valued, possibly reflecting supply-side industry changes such as the transition from distance-based to revenue-based loyalty programs and the growing monetization of airline miles through credit card partnerships, or demand-side preferences as consumers increasingly treat miles as a cash-like payment mechanism.

Despite this convergence, award tickets continue to differ from paid fares along certain dimensions, particularly with respect to the characteristics of origin and destination airports. In particular, these results suggest that award tickets are more likely than paid tickets to originate from airports with a higher own-carrier share. This pattern, observed across both legacy and LCCs, aligns with the expectation that passengers based at carrier-dominated airports are more likely to accrue and redeem frequent flyer miles. This dynamic reinforces the advantages carriers enjoy at hub airports and may contribute to the persistence of hub premiums observed in the literature, as loyalty programs strengthen customer retention and reduce effective competition.[38]

Award tickets are also disproportionately associated with destinations exhibiting higher seasonal variation in demand, relative to paid tickets. This finding implies that frequent flyer miles may be more often redeemed for discretionary, leisure-oriented travel, especially with legacy carriers.[39] The magnitude of this difference has remained relatively stable through the relevant period, suggesting a persistent distinction between paid and award travel in the types of destinations.

[38] It is also possible that higher levels of award ticket redemption may contribute to positive hub premium estimates, especially for carriers with capacity constraints at those airports. For example, if the redemption of FFAs displace lower-fare paid tickets, and the analysis drops all fares under $20, then the average observed fare would mechanically increase at airline-airport combinations with higher redemption activity. In addition, the value passengers assign to earning a carrier's frequent flyer miles may be higher at dominant-share airports, where customers face a broader set of redemption (and earning) opportunities and may expect a higher likelihood of reaching redemption thresholds before expiration.

[39] This persistent difference may also reflect the behavior of travelers that accrue frequent flyer miles through business travel that they may not directly pay for, and subsequently use those accrued miles for vacations.

5 Frequent flyer redemptions and price dispersion

As discussed in Section 1, it is ambiguous whether loyalty programs increase or decrease competition in markets where they are present. While many argue that these programs are anticompetitive because introducing switching costs generally raises prices, creates barriers to entry, and generates deadweight losses (Banerjee and Summers, 1987; Cairns and Galbraith, 1990; Fong and Liu, 2011; Kim et al., 2001; Klemperer, 1995), others argue that loyalty programs are "business stealing devices" that enhance competition and increase total surplus (Caminal, 2012; Caminal and Claici, 2007; Caminal and Matutes, 1990).

Similar to the large body of literature that examines the relationship between competition and price discrimination, we examine whether the share of passengers traveling on frequent flyer awards in a market increases or decreases an airline's ability to price discriminate. If loyalty programs enhance market power, then an increase in the share of frequent flyer passengers in a market should increase an airline's ability to price discriminate (i.e., the dispersion of that carrier's fares in the market should increase). However, if loyalty programs enhance competition, then an increase in the share of frequent flyer passengers should decrease an airline's ability to price discriminate (i.e., the dispersion of that carrier's fares in the market should decrease).

5.1 Price dispersion regression model

Following Borenstein and Rose (1994), Gerardi and Shapiro (2009), Dai et al. (2014) and several other previous studies of airline pricing, we rely on the Gini coefficient as our measure of price dispersion.[40] Consistent with prior literature (and in an effort to focus on the effect of FFAs on paid tickets), we calculate the Gini coefficient for each nonstop route excluding all fares under \$20. The median Gini coefficient we find for 2005–2019 is 0.24, which is similar to the

[40]In our context, the Gini coefficient measures how far the distribution of an airline's fares on a route deviates from a completely equal distribution. Specifically, the Gini coefficient is equal to twice the expected absolute difference between two fares that are randomly drawn from the population. For example, a Gini coefficient of 0.20 for a given carrier and route implies an expected absolute difference of 40 percent of the mean fare for two randomly selected passengers traveling on that carrier and route.

median coefficients for nonstop routes in Gerardi and Shapiro (2009) (0.22 for 1993–2006) and Dai et al. (2014) (0.23 for 1993–2008). To determine how competition and the share of frequent flyer passengers affects price dispersion, we estimate equation (2) below,

$$ln[Gini_{mkt}/(1 - Gini_{mkt})] = \beta_0 + \beta_1 \cdot \text{HHI}_{mt} + \beta_2 \cdot \text{FREQUENT FLYER SHARE}_{mkt} + \gamma_{kt} + \delta_{km} + \epsilon_{mkt} \quad (2),$$

where $Gini_{mkt}$ is the Gini coefficient of ticketing carrier k's fares in market m and quarter t. To ensure that a linear estimator can be used to estimate equation (2), we employ the Gini log-odds ratio as our dependent variable to unbound the inequality index. γ is an airline-year-quarter fixed effect that controls for any unobserved time-varying airline-specific effects (e.g., carrier-specific demand shocks). δ is an airline-market fixed effect that controls for unobserved time-invariant factors that affect an airline's demand in a given market. HHI is the Herfindahl-Hirschman Index for the market measured on a scale from 0 to 1.

The coefficient of interest in equation (2) is β_2, as this coefficient measures how the share of frequent flyer passengers (measured on a 0 to 100 scale) on a carrier in a given market affects that carrier's fare dispersion. We also estimate equation (2) with the natural log of the 10th and 90th percentile fares as the dependent variables to better understand how competition and the share of frequent flyer passengers affects prices across the distribution.

HHI in equation (2) is potentially endogenous. For example, an airline may be more likely to enter a route that has higher levels of price dispersion as they anticipate the ability to undercut some of the prices. To address this potential endogeneity, we estimate equation (2) using two-stage least squares (2SLS). Following Borenstein and Rose (1994), Gerardi and Shapiro (2009), Dai et al. (2014), and Gaggero and Luttmann (2023), we instrument for HHI using (i) measures of passengers enplaned on the route[41] and (ii) measures of the endpoint city populations.[42] The rationale behind these instruments is straightforward. Passenger traffic and the population of the endpoint cities impact the suitability of a given route to a particular airline's fleet type and size,

[41]Specifically, we use the natural log of the total passenger traffic in the market across all carriers and the "genp" measure introduced by Borenstein and Rose (1994).

[42]We use the natural log of both the geometric and arithmetic means of the Metropolitan Statistical Area populations of the endpoint airports.

which directly affects an airline's route entry decision (and thus, the overall level of competition on the route). More importantly, there is no reason to believe that city populations or passenger traffic levels are direct determinants of price dispersion.

There are also two reasons to believe that the potential simultaneity bias that results from an airline's decision to enter or exit a given market is not a major concern. Foremost, the inclusion of airline-year-quarter and airline-market fixed effects likely eliminates a large degree of bias associated with the correlation between price dispersion and HHI. Second, Gayle and Wu (2013) demonstrate that accounting for endogenous carrier entry using a structural model has a negligible impact on estimated competition effects in a subsequent fares regression, implying that simultaneity bias is minimal in analyses of U.S. airline pricing. For these reasons, we present both OLS and 2SLS results in the following subsection.

5.2 Price dispersion analysis results

Table 5 presents results from the model specified by equation (2). Panel A presents OLS results while Panel B presents 2SLS results. Columns (1), (4), and (7) present results with the natural log of the Gini log odds ratio as the dependent variable. Columns (2), (5), and (8) present results with the natural log of the 10th percentile fare as the dependent variable. Finally, columns (3), (6), and (9) present results with the natural log of the 90th percentile fare as the dependent variable.

Consistent with prior literature (Borenstein and Rose, 1994; Dai et al., 2014; Gerardi and Shapiro, 2009), the analysis in Table 5 is limited to nonstop flights. To prevent markets with low amounts of passenger traffic from disproportionately affecting results and to ensure a large enough dispersion of prices to calculate a Gini coefficient, we limit the analysis to airline-market observations with at least 50 DB1B passengers in columns (1)-(3), 100 DB1B passengers in columns (4)-(6), and 200 DB1B passengers in a quarter in columns (7)-(9).[43] Our preferred specifications are provided in columns (4)-(6), since these results apply the same DB1B passenger cutoff that

[43]Because the DB1B is a 10% sample of all tickets, these cutoffs correspond to airline-market observations with 500, 1,000, and 2,000 passengers in a quarter, respectively.

was used in Gerardi and Shapiro (2009).[44]

As discussed in Section 5.1, HHI may be endogenous due to simultaneity bias that arises from an airline's decision to enter or exit a given market. This bias tends to attenuate the OLS estimates of HHI downward. Consistent with this expectation, the 2SLS estimates of HHI in all specifications of Table 5 are larger than the corresponding OLS estimates reported in Panel A. The Kleibergen-Paap rk Wald F statistics in every column of Table 5 are also statistically significant, indicating that our instruments are both strong and relevant.[45]

In columns (1), (4), and (7), the positive and statistically significant coefficients on $Frequent$ $Flyer\ Share$ indicate that a higher proportion of frequent flyer passengers on a route is associated with greater price dispersion of paying passengers. Comparing columns (2) and (3), (5) and (6), and (7) and (8), this increase in price dispersion appears to be driven by larger fare increases at the 90th percentile, rather than the 10th percentile. This finding supports the theory that loyalty programs enhance market power: as the share of frequent flyer passengers rises, airlines gain more flexibility to engage in price discrimination. These results also demonstrate that higher levels of frequent flyer passengers increase fares across the entire price distribution, supporting the conjecture that FFAs serve as quantity discounts for customers who exhibit brand loyalty. Hence, consumers are effectively increasing their own switching costs by paying higher ticket prices in the hopes of receiving future free travel.

It is important to note that the results in Table 5 would also be consistent with FFA tickets truncating the bottom portion of a lognormal fare distribution. For example, our descriptive analysis in Section 4 revealed that FFAs are disproportionately redeemed on routes to seasonal vacation destinations, implying that price-sensitive leisure travel likely comprises the bulk of FFA travel.

[44] The specifications in columns (1)-(3) apply the same DB1B passenger cutoff as Borenstein and Rose (1994).

[45] Because we have more instruments (four) than endogenous variables (one), we are able to test whether our overidentifying restrictions are valid using Hansen's J Test. Unfortunately, we reject the null hypothesis of valid overidentifying restrictions. As discussed in Section 5.1, the OLS results presented in Panel A of Table 5 may be more appropriate because the simultaneity bias that results from an airline's decision to enter or exit a market has been shown to be negligible in Gayle and Wu (2013).

Table 5: Price Dispersion Results

Dependent variable:	$ln[Gini/(1-Gini)]$	ln(P10)	ln(P90)	$ln[Gini/(1-Gini)]$	ln(P10)	ln(P90)	$ln[Gini/(1-Gini)]$	ln(P10)	ln(P90)
Passenger Cutoff:	50 DB1B Passengers	50 DB1B Passengers	50 DB1B Passengers	100 DB1B Passengers	100 DB1B Passengers	100 DB1B Passengers	200 DB1B Passengers	200 DB1B Passengers	200 DB1B Passengers
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. *OLS Results*									
FREQUENT FLYER SHARE	0.0015**	0.0050**	0.0078**	0.0016**	0.0057**	0.0086**	0.0015**	0.0066**	0.0093**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
HHI	-0.1272**	0.3292**	0.2418**	-0.1316**	0.3411**	0.2490**	-0.1249**	0.3440**	0.2549**
	(0.0085)	(0.0087)	(0.0093)	(0.0093)	(0.0096)	(0.0100)	(0.0109)	(0.0110)	(0.0113)
Observations	583,503	583,507	583,507	472,835	472,837	472,837	335,055	335,056	335,056
Adjusted R^2	0.649	0.849	0.863	0.667	0.861	0.869	0.691	0.869	0.876
Panel B. *2SLS Results*									
FREQUENT FLYER SHARE	0.0016**	0.0042**	0.0069**	0.0015**	0.0050**	0.0077**	0.0014**	0.0060**	0.0084**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
HHI	-0.0816**	1.0072**	1.0972**	-0.0875**	0.9960**	1.0479**	-0.0872**	0.9560**	0.9736**
	(0.0207)	(0.0287)	(0.0288)	(0.0212)	(0.0300)	(0.0286)	(0.0239)	(0.0326)	(0.0297)
Observations	556,279	556,283	556,283	456,952	456,954	456,954	326,897	326,898	326,898
Kleibergen-Paap χ^2 Stat.	1192.9**	1192.9**	1192.9**	1120.8**	1120.8**	1120.8**	950.2**	950.2**	950.2**
Kleibergen-Paap Wald F Stat.	724.4**	724.4**	724.4**	695.5**	695.5**	695.5**	584.5**	584.5**	584.5**
Hansen J Stat.	98.0**	207.0**	157.5**	83.6**	220.9**	147.8**	76.0**	209.2**	116.9**

Notes: All regressions include airline-quarter-year and airline-market fixed effects. The analysis sample in columns (1)-(3) is limited to nonstop routes and airline-market observations with at least 50 passengers in the DB1B for that quarter. The analysis sample in columns (4)-(6) is limited to nonstop routes and airline-market observations with at least 100 passengers in the DB1B for that quarter. The analysis sample in columns (7)-(9) is limited to nonstop routes and airline-market observations with at least 200 passengers in the DB1B for that quarter. Standard errors clustered at the market (i.e., airport-pair) level are reported in parentheses. The sample period is 2005Q1-2019Q4. Fares are deflated using the Bureau of Economic Analysis Gross Domestic Product: Implicit Price Deflator (GDPDEF) indexed to quarter 4 of 2019. In Panel B, HHI is treated as an endogenous variable and instrumented for using measures of enplaned passengers and endpoint city populations. ** Significant at the 1 percent level. * Significant at the 5 percent level.

Hence, if the ex-ante distribution of fares on a given route is lognormal (e.g., a larger proportion of discount economy tickets relative to more expensive premium economy tickets), then truncating the bottom portion of the fare distribution would result in a new distribution that exhibits greater price dispersion.

6 Conclusion

Firms introduce loyalty programs to attract and retain customers, but it is unclear whether these programs enhance or reduce competition in markets where they are present. This paper introduces a novel method to identify rewards for one of the most prominent industries that employ loyalty programs, airlines. Using this method, we document where and how frequent flyer awards (FFAs) are redeemed and how these patterns vary between legacy and low-cost carriers (LCCs).

Across both carrier types, we find that FFAs are more likely to be redeemed on routes to leisure and seasonal destinations, with particularly strong patterns for legacy carriers. FFAs also originate disproportionately from airports where the issuing airline holds a high share of total traffic, reinforcing the link between frequent flyer programs and carrier dominance at hub airports. These findings are consistent with theories of customer lock-in and the hub premium, where carriers leverage loyalty to insulate themselves from competition.

In contrast to these more persistent patterns in origin and destination choice, we observe a steady convergence over time between award and paid travel in terms of observable trip characteristics, such as distance flown, number of segments, and likelihood of a nonstop itinerary. These differences, especially pronounced for LCCs in the early 2000s, decline throughout our sample period and are largely indistinguishable by 2019. This convergence is suggestive of a broader shift in how frequent flyer awards are used and valued, possibly reflecting supply-side industry changes such as the transition from distance-based to revenue-based loyalty programs and the growing monetization of airline miles through credit card partnerships, or demand-side preferences as consumers increasingly treat miles as a cash-like payment mechanism.

Further, we find that routes with large shares of frequent flyer passengers have higher levels of price dispersion. This finding suggests that airline loyalty programs may enhance market power, as they appear to increase an airline's ability to price discriminate. However, it is also possible that this finding is a result of FFA tickets effectively truncating the bottom portion of a fare distribution that is ex-ante distributed lognormally.

Our findings contribute to ongoing debates about the role of loyalty programs in shaping market structure and consumer welfare. Frequent flyer programs may enhance airline market power by raising switching costs, increasing customer retention, and enabling greater price discrimination. These dynamics have attracted some regulatory attention, particularly in the context of airline alliances, codesharing agreements, and merger reviews. More broadly, loyalty programs have grown rapidly outside the airline industry, including in hospitality, retail, telecommunications, and financial services. These programs often rely on similar mechanisms of consumer segmentation, switching cost creation, and reward-based targeting. Because the airline industry offers unusually detailed public data and a long history of regulatory oversight, it provides a valuable setting for developing tools to empirically analyze the competitive effects of loyalty programs more generally. Insights from airline reward behavior can help inform how loyalty programs operate across sectors and what economic benefits or consequences they generate. Future research on redemption patterns, devaluation dynamics, and consumer heterogeneity in loyalty valuation could help antitrust and regulatory agencies better evaluate how these programs affect market outcomes, both within and beyond aviation. Our novel method contributes to this effort by making award travel empirically identifiable in one of the most widely used datasets in empirical industrial organization.

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APPENDIX A: Number of Frequent Flyer Awards

Table A1: Number of Frequent Flyer Awards Redeemed
(millions of tickets)

Airline	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alaska (AS)	0.8	0.9	1.1	1.4	1.4	1.7	*	*	*	*	*	*	*	*	*
American (AA)	5.2	5.2	5.2	6.2	5.2	5.6	6.0	6.0	6.1	7.9	8.3	10.0	11.0	13.0	14.0
Continental (CO)	1.4	1.5	1.5	1.6	1.3	1.6	1.9	Acquired by United (UA)							
Delta (DL)	3.3	*	*	*	*	12.0	12.0	11.0	11.0	12.5	13.3	13.4	14.9	17.2	20.0
Hawaiian (HA)	*	*	*	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.7
JetBlue (B6)	0.1	0.2	0.2	0.3	0.3	0.6	0.6	0.8	0.9	1.1	1.4	1.6	2.0	2.0	3.0
Northwest (NW)	1.5	1.5	*	*	Acquired by Delta (DL)										
Southwest (WN)	2.6	2.7	2.8	2.8	3.0	3.2	3.7	4.5	5.4	6.2	7.3	8.3	9.6	10.4	10.7
United (UA)	2.2	2.3	2.2	2.3	2.1	2.4	2.5	4.7	5.0	4.8	5.0	5.2	5.4	5.6	6.1
U.S. Airways (US)	1.3	0.5	0.9	0.9	0.8	0.8	0.8	0.8	1.8	Merged with American (AA)					

Source: 2005-2019 Form 10-K filings for Alaska, American, Continental, Delta, Hawaiian, JetBlue, Northwest, Southwest, United, and U.S. Airways.

Notes: *Number not reported in Form 10-K filing. Numbers are reported in millions. AirTran (FL), Frontier (F9), Spirit (NK), and Virgin America (VX) are not included because they do not report the number of frequent flyer awards in their annual Form 10-K filings. Allegiant (G4) introduced their frequent flyer program in August 2023.

APPENDIX B: Continental and United

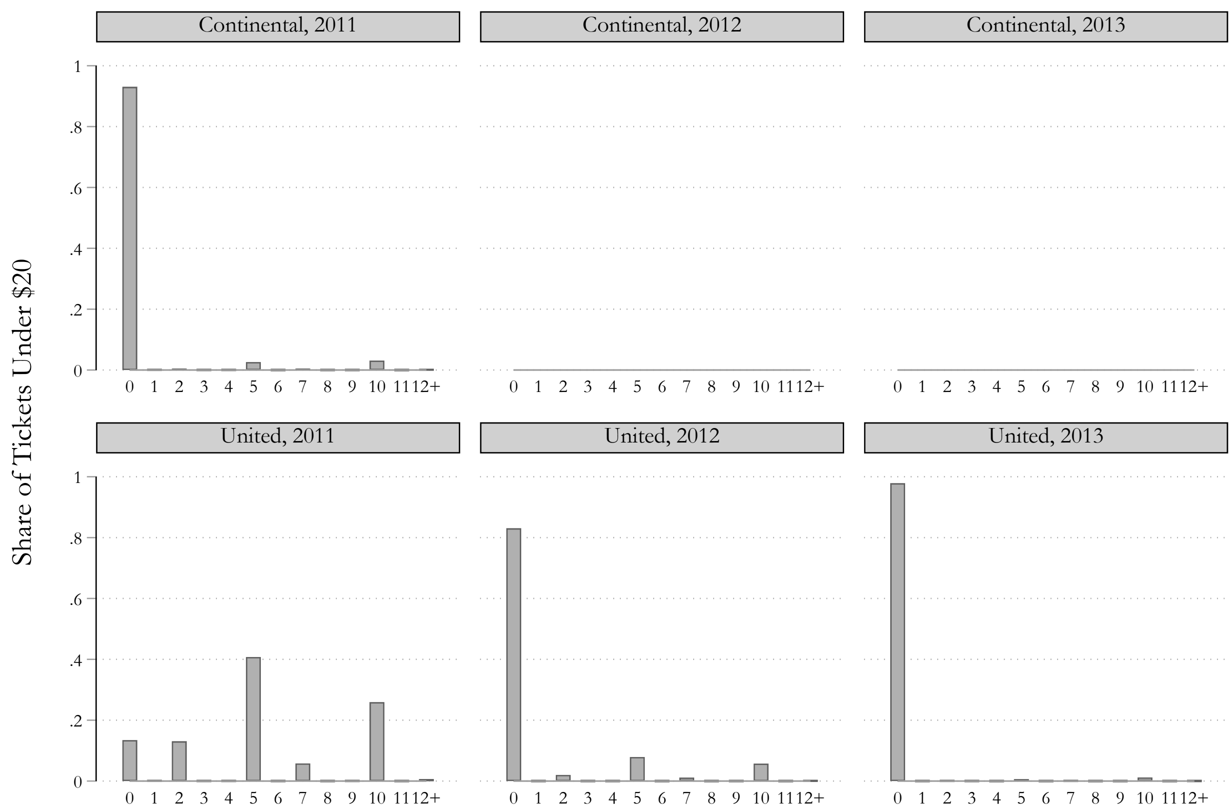
As mentioned in Table 4, Continental appears to report frequent flyer award (FFA) tickets in the Airline Origin and Destination Survey (DB1B) with an itinerary fare of zero. United also appears to report FFA tickets with a fare of zero after their merger with Continental (2012-2019). To illustrate this phenomenon, Figure B1 plots the distribution of DB1B fares under $20 for Continental and United in 2011, 2012, and 2013.

Consistent with our FFA identification strategy described in Section 3, spikes in the distribution of United's fares occur at $2, $5, $7, and $10 in 2011. However, these spikes largely disappear in the 2012 and 2013 plots after Continental's reservation system and frequent flyer program were merged into United's on March 3, 2012.[46] Additionally, the distribution of Continental's fares in 2011 has a large spike at $0 but no spikes at $2, $5, $7, and $10. These plots suggest that Continental reports FFA tickets in the DB1B with an itinerary fare of zero. Furthermore, researchers should be aware that all Continental tickets in addition to United tickets after March 3, 2012 are likely not inclusive of ticket taxes and fees since the Passenger Fee does not appear to be reflected in their DB1B observations. Accordingly, researchers should consider adding the applicable Passenger Fee to all reported Continental fares and United fares after March 3, 2012 or include the appropriate level of fixed effects (e.g., airline-time and airline-route) in their empirical analyses.

Finally, we do not classify Continental or United tickets with an itinerary fare of $0 as FFAs in the analysis presented in Sections 4 and 5. However, the results presented in this paper do not materially change if all Continental tickets with a fare of $0 and all United tickets after March 3, 2012 with a fare of $0 are classified as FFAs (results from these robustness checks are available upon request).

[46] Although the United-Continental merger closed on October 1, 2011, the Federal Aviation Administration did not grant a single operating certificate to United until November 30, 2011. Continental's reservation system and OnePass Frequent Flyer miles program were officially merged into United's on March 3, 2012.

Figure B1: Distribution of DB1B Fares Under $20 for Continental and United in 2011, 2012, and 2013



Notes: Data are from DB1B files for 2011, 2012, and 2013 and limited to one-way itineraries with three or fewer segments and round trip itineraries with six or fewer segments. Bars represent the share of passengers with tickets under $20 that reported that exact itinerary fare.