Incumbent Response to Entry by Low-Cost Carriers in the U.S. Airline Industry*

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Abstract

This paper studies incumbent price response to entry by low-cost carriers in the U.S. airline industry. I find that legacy carrier incumbents decrease their mean airfare, 10th percentile airfare, and 90th percentile airfare following entry by a low-cost carrier. Airfares decrease by a larger percentage at the right tail of the incumbents' price distribution than at the left tail, suggesting that increased competition from low-cost carrier entrants leads to lower price dispersion.

JEL classifications: L93, L11

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1 Introduction

When a firm enters a market consisting of a brand-loyal segment and a price-sensitive segment, there are two possible effects on the incumbents' pricing strategy: the competitive effect and the displacement effect. Once the entrant enters, the incumbent could decrease prices in order to keep customers because the demand for the incumbent firm decreases and becomes more elastic. Klemperer (1987) and Perloff and Salop (1985) refer to this as the competitive effect. On the other hand, Rosenthal (1980) and Hollander (1987) provide the theoretical foundation for the displacement effect, in which entry can actually cause incumbents to increase their prices due to the existence of the two market segments. If entrants are known to cater toward price-sensitive consumers, then incumbents may be best served by increasing prices. In effect, these incumbents will focus their attention on their brand-loyal consumers, who will continue purchasing from them even if an entrant offers relatively lower prices. This paper seeks to empirically analyze which of these effects is more dominant using data on the U.S. airline industry.

The expansion of several low-cost carriers' route network between 1993 and 2009 allows for the ability to study how legacy carrier incumbents respond to low-cost carrier entry. Legacy carriers are airlines that operate a hub-and-spoke network and were founded prior to the industry's deregulation in 1978, while low-cost carriers typically implement a point-to-point network and emerged after deregulation.[1] In particular, this paper studies six legacy carriers (American Airlines, Continental Airlines, Delta Air Lines, Northwest Airlines, United Airlines, and US Airways) and four low-cost carriers (AirTran Airways, JetBlue Airways, Southwest Airlines, and Spirt Airlines).[2]

The purpose of this paper is to investigate how legacy carrier incumbent pricing strategy changes in response to entry by low-cost carriers. The results show that legacy carrier incumbents decrease their average airfares once a low-cost carrier enters a route, which is consistent with the competitive effect. Moreover, there is an existing literature that identifies the Southwest Effect, in

[1] See Borenstein (1992) for a detailed discussion about the differences between legacy carriers and low-cost carriers.

[2] The selection of low-cost carriers used in this study follows the list of low-cost carriers in Gerardi and Shapiro (2009) that operated in the U.S. during 2009, the last year of the dataset used in this paper.

which incumbent airlines decrease their average airfare when Southwest Airlines enters a route.[3] Since each of the four low-cost carriers place downward pressure on incumbent's mean airfares, the results imply that the Southwest Effect phenomenon applies not only to Southwest Airlines but also to other low-cost carriers. This paper also sheds light on a different strand in the literature that studies the effect of competition on price dispersion. Incumbent airlines decrease their 10th percentile airfares by less than mean airfares, whereas their 90th percentile airfares decrease by more than mean airfares. Consequently, legacy carrier incumbent's price dispersion, as measured by the Gini coefficient or by standard deviation of airfares, decreases in response to low-cost carrier entry.

Previous papers have studied how competition influences airlines' ability to engage in price discrimination. For example, Borenstein and Rose (1994) conduct a cross-sectional study that finds that price dispersion increases with competition, which is measured using the route-level Herfindahl Index. By contrast, Gerardi and Shapiro (2009) use panel data to conclude that price dispersion decreases with competition, which is proxied using three different measures: (1) the route-level Herfindahl Index, (2) the total number of competitors on a route, and (3) the number of legacy carriers and low-cost carriers servicing a route. In other words, Gerardi and Shapiro (2009) find that the difference between more expensive full fares (90th percentile airfares) and cheaper discount fares (10th percentile airfares) is smaller for routes that are serviced by more airlines. This paper analyzes that research question in a different manner. Instead of looking at how varying concentration levels of firms impact price dispersion across all routes like in both Borestein and Rose (1994) and Gerardi and Shapiro (2009), I focus on how price dispersion changes on the subset of routes that are entered by low-cost carriers, such that increased competition stems from the additional presence of the entrant. The results in this paper provide supporting evidence to the conclusions made in Gerardi and Shapiro (2009). By investigating how the Gini coefficient and the tails of the incumbents' price distribution respond to entry, this paper contributes to the literature on the effect of competition on the price distribution of rival firms.

[3] See Morrison (2001) and Vowles (2001) for details on the Southwest Effect.

2 Entry and Price Dynamics

The competitive structure of the U.S. airline industry has gone through several changes since deregulation in 1978. Airlines have since experienced more flexibility in their route network and pricing strategies. It is easier to enter routes that were once heavily regulated by the Civil Aeronautics Board. As a result, there has been an influx of entry over the past three decades by low-cost carriers, who benefit from the implementation of a point-to-point network and operation of the same type of aircraft.[4] This is in stark contrast to legacy carriers, which implement a hub-and-spoke network and operate with a variety of different aircrafts. Legacy carriers get their name because they were founded and operated prior to deregulation. Indeed, Smyth and Pearce (2006) find that low-cost carriers have a lower cost per seat kilometer than legacy carriers, allowing low-cost carriers to charge relatively lower prices.

Low-cost carriers have gained market share in the airline industry, particularly in the past decade. In 1999, low-cost carriers flew over 62 million passengers total and accounted for 23.2% of the market share of all passengers flying domestically. In 2007, the number of passengers flying with low-cost carriers increased to over 119 million passengers, resulting in a 38.6% market share of all domestic travel. This growth can be partly attributed to the expansion of the low-cost carriers' route network. Among the top 150 most traveled airports, there were 2,906 instances of entry from 1993:Q1 to 2009:Q4 by low-cost carriers, with Southwest Airlines entering 1,286 routes, AirTran Airways entering 1,224 routes, JetBlue Airways entering 340 routes, and Spirit Airlines entering 56 routes. Each route is defined as a particular one-way airport-pair. For example, two routes were considered to be entered when Southwest Airlines started flying from Orlando International Airport to Philadelphia International Airport and vice versa in 2004:Q2. This paper examines four currently operating low-cost carriers (AirTran Airways, JetBlue Airways, Southwest Airlines, and Spirit Airlines) who have grown substantially over the past two decades and who remain significant players in the airline industry today.[5]

[4]For example, Southwest Airlines exclusively uses Boeing 737 jets.

[5]This paper does not study the entry effect of legacy carriers because the data indicates that these airlines did not enter a significant number of routes during this time period.

Previous research has studied the effect of brand loyalty on the demand for flying. Borenstein (1989) and Gilbert (1996) describe how airlines employ marketing schemes in the form of frequent flier programs in order to create and strengthen consumers' brand loyalty for that particular airline. Consumers enroll in an airline's frequent flier program and accumulate credit each time they fly with that particular airline. Members can redeem their credit for free flights, upgrades, or other rewards from that airline. Brand-loyal consumers effectively experience a switching cost upon enrollment in a particular airline's frequent flier program. Kim, Shi, and Srinivasan (2001) explore how these marketing programs can create two market segments: brand-loyal consumers and price-sensitive consumers.[6] Brand-loyal consumers tend to be members of a particular airline's frequent flier program and become disposed to purchasing more flights using that airline. Price-sensitive consumers simply look to fly with the airline charging the lowest price for a given route. Borenstein (1992) explains how consumers are inclined to participate in a particular airline's frequent flier program when they live in that airline's hub city. For example, Delta Air Lines uses Hartsfield-Jackson Atlanta International Airport as a hub. Consumers in Atlanta are more likely to not only fly with Delta but also enroll in Delta's frequent flier program in order to benefit from the wide selection of markets serviced out of Atlanta. This ultimately serves to hook passengers to that particular airline, who can then exploit their brand-loyal segment by increasing prices without the fear of losing a significant amount of their market base. In other words, members of an airline's frequent flier program will continue to purchase from that carrier even if they were charged a higher price because these consumers want to obtain an award after purchasing a certain amount of trips from that airline. Therefore, brand loyalty serves as a switching cost for consumers.

There is empirical evidence for the displacement effect in industries which parallel the airline industry. Using data on the pharmaceutical industry, Frank and Selkever (1997) and Grabowski and Vernon (1992) found that entry by generic drugs induced firms selling branded prescription drugs to target brand-loyal consumers, leaving generic drugs to focus on price-sensitive

[6] The authors refer to the brand-loyal consumers and price-sensitive consumers as the heavy-user segment and the light-user segment, respectively.

consumers. This led to an increase in the price of branded drugs, exemplifying the case when the displacement effect is more prominent than the competitive effect. The airline industry can be considered analogous to the prescription drug market in the sense that brand loyalty is prevalent in both industries with legacy carriers similar to branded prescription drugs and low-cost carrier entrants akin to generic drugs.

It is possible that legacy carrier incumbent airlines similarly segment the market once a low-cost carrier enters a route.[7] Incumbents can focus on the brand-loyal segment of the market and allow entrants to service the price sensitive market segment, which would increase price dispersion. Thus, the displacement effect dominates if incumbent airlines focus solely on brand-loyal consumers, resulting in an increase of the incumbent's average price and price dispersion. However, the competitive effect dominates if entry leads to stronger competition for price sensitive consumers, resulting in a decrease in the incumbent's average price. Furthermore, decreasing prices at the left tail of the price distribution could induce incumbents to also decrease prices at the right tail of the distribution in order to prevent brand-loyal consumers from becoming more price sensitive. If there was a substantial difference between full fares and discount fares, then brand-loyal consumers would substitute between competing carriers.

The existing literature on low-cost carriers provides evidence that the dominance of the competitive effect is plausible. Morrison (2001) and Vowles (2001) both document evidence that incumbents decrease price when Southwest Airlines enters a new market – the so-called Southwest Effect. However, given the nature of the airline industry, it is possible that the displacement effect dominates as in the pharmaceutical industry. Therefore, it could be argued that incumbents would increase their price in response to entry by a low-cost carrier. This paper serves to empirically test whether the competitive effect or the displacement effect more strongly characterizes the pricing strategy of legacy carrier incumbents in response to low-cost carriers in the U.S. airline industry.

[7]This paper focuses on the response by legacy carrier incumbents because there are not enough observations of low-cost carrier incumbents facing entry by a rival low-cost carrier to estimate the price response of these low-cost carrier incumbents. Moreover, the key results are qualitatively similar when pooling all entrant airlines together.

3 Data

The data used for this paper was collected from the Airline Origin and Destination Survey (DB1B), which is published quarterly by the Bureau of Transportation Statistics. It is a ten percent sample of airline tickets from carriers flying domestic routes. From this database, I collected information on the origin, destination, non-stop distance between endpoints, ticketing carrier, market fare, and number of passengers paying a particular market fare. The market fare is the one-way price paid by a passenger for a specific origin-destination route on a particular carrier. Data was collected from 1993:Q1 and 2009:Q4.[8]

The following steps were implemented to clean the data. I eliminated all observations where the market fare is less than $20, which removes observations pertaining to frequent-flyer trips and is common in the literature. Observations with an unidentified ticketing carrier were also dropped, while only observations related to nonstop flights were kept. Following Borenstein (1989), observations pertaining to carriers who have less than 1% of the traffic on a given route were eliminated. I then restrict the sample to routes between the top 150 airports in the continental United States based on the number of passengers since no low-cost carriers entered a route with an endpoint airport ranked lower than 150 during the sample time period.[9] The final data set contains 2,008,446 carrier-route-year-quarter observations on 4.54 trillion passengers traveling on 15,816 routes between 134 airports over the 17 year time period.[10]

In order to be classified as a legitimate entry occurrence, the entrant (1) must not have operated on the route for twelve quarters prior to the quarter of entry and (2) must remain on the route for at least eight quarters after entry. This criteria is important for two reasons. Given that the DB1B is a ten percent sample of domestic airline travel, there are some thin routes where an

[8]Although the Bureau of Transportation Statistics makes data from 1993 to the present available, the competitive environment of the U.S. airline industry could have been affected by the completion of the Delta-Northwest merger in 2009. As such, 1993-2009 provides a clean time frame to analyze entry by low-cost carriers.

[9]The top ranked airport in 2009 is Hartsfield-Jackson Atlanta International Airport (ATL), whereas the 150th ranked airport is Phoenix-Mesa Gateway Airport (IWA). Southwest Airlines entered eight routes involving Corpus Christi International Airport (CRP) between 1993 and 2009. As the 137th ranked airport, CRP is the smallest endpoint airport of entered routes during the sample time period.

[10]Legacy carriers service only 134 of the top 150 airports in the United States.

airline will intermittently cease to exist in the dataset. Entry should not be deemed to occur when an airline consistently services a route except for one anomalous year-quarter. Hence, criterion (1) assures that there will be no false positive entry instances. A second concern may arise if incumbents attempt a predatory pricing scheme in order to deter entry.[11] Thus, criterion (2) ensures that the incumbent price response does not capture the initial price decrease and subsequent price increase consistent with a predatory pricing scheme.

4 Empirical Analysis

I study three different responses to entry in order to give a more complete analysis on the entry effect of low-cost carriers. First, I examine how incumbents change their mean airfare following entry by a low-cost carrier. Second, I investigate how the incumbents' price distribution of airfares is affected by that entry. In particular, I look at how the tails of the distribution (10th percentile airfare and 90th percentile airfare) change following entry. Finally, I also examine the entry effect on two measures of the incumbent's price dispersion: the Gini coefficient and standard deviation of airfares. The Gini coefficient is commonly used as a measure for fare inequality, which arises from the fact that different passengers pay different prices for the same flight serviced by a particular carrier. In fact, Borenstein and Rose (1994), Hayes and Ross (1998), and Gerardi and Shapiro (2009) all use the Gini coefficient in their estimation strategy. The Gini coefficient is constructed to be between zero and one, where inequality increases as the Gini coefficient increases. In other words, a Gini coefficient of zero represents perfect equality, whereas a Gini coefficient of one signifies perfect inequality. In the context of the airline industry, a Gini coefficient of zero means that all passengers pay the same price for a specific route serviced by a particular carrier, whereas an increase in the carrier's Gini coefficient implies that there is more price dispersion on a particular route.

[11] See Elzinga and Mills (2005) for details on the *Spirit Airlines v. Northwest Airlines* predatory pricing case.

4.1 Estimation Strategy

Following the estimation strategy in Gerardi and Shapiro (2009), I use a two-way fixed effects model to identify the entry effects on incumbents' prices.[12] Five dependent variables were used, including the natural log of mean airfare (*lnPrice*), the natural log of 10th percentile price (*lnP*10), the natural log of 90th percentile price (*lnP*90), the log-odds ratio of the Gini coefficient (*loddGini*), and the natural log of standard deviation of prices (*lnSD*). Since the Gini coefficient is constructed to be bounded between zero and one, the log-odds ratio of the Gini coefficient is used in order to create an unbounded dependent variable. Following Gerardi and Shapiro (2009), the log-odds ratio of the Gini coefficient (*Gini*) is defined as $loddGini = ln\left[\frac{Gini}{(1-Gini)}\right]$.

The basic specification is as follows:

$$y_{ij,t} = \alpha + \sum_{\tau=-4}^{4} \beta_\tau Entry_{j,t_0+\tau} + \theta_1(-lnHERF_{j,t}) + \theta_2 Bankrupt_{i,t} + \gamma_t + \nu_{ij} + \varepsilon_{ij,t}, \qquad (1)$$

where $y_{ij,t}$ is either $lnPrice_{ij,t}$, $lnP10_{ij,t}$, $lnP90_{ij,t}$, $loddGini_{ij,t}$, or $lnSD_{ij,t}$ for incumbent airline i on route j in time t. Year-quarter and carrier-route fixed effects are denoted as γ_t and ν_{ij}, respectively. The two control variables used in Gerardi and Shaprio (2009) are also included: $-lnHERF_{j,t}$, the negative value of the natural log of route j's Herfindahl Index in time t, and $Bankrupt_{i,t}$, an indicator variable for whether incumbent airline i is bankrupt in time t.[13] The key variables of interest, $Entry_{j,t_0+\tau}$, are the time dummies that specify the lag/forward of the low-cost carrier actually entering route j in time period t_0. The standard errors are clustered by carrier-route to account for heteroskedasticity and for correlation between a carrier-route combination over time. Table 1 provides summary statistics.

The main distinction between the regression model in Gerardi and Shapiro (2009) and in this

[12]The final data set for this paper produces qualitatively similar results to the main results in Gerardi and Shapiro (2009), which is available upon request from the author.

[13]Gerardi and Shapiro (2009) use three different measures for competition: (1) the negative value of the natural log of route-level Herfindahl Index, (2) the natural log of the total number of competitors, and (3) the number of legacy carriers and the number of low-cost carriers servicing a route. I elect to use the first measure since this is also the key variable of interest in Borenstein and Rose (1994). As in Gerardi and Shapiro (2009), the results in this paper are qualitatively similar when including either of these three measures of competition and are available upon request from the author.

paper is the inclusion of nine time dummies that account for four quarters before actual entry to four quarters after actual entry, including the actual quarter of entry. Analyzing the price response starting one year before entry is appropriate since low-cost carriers publicly announce their entry decisions typically two quarters in advance.[14] For example, Southwest Airlines announced on November 8, 2007 that they will start servicing nonstop flights between Denver International Airport and San Diego International Airport on April 4, 2008.[15] The estimates of the time lags/forwards of entry show the relative sizes of the dependent variable in the dummy time period versus its average value in the excluded period (the ninth to twelfth quarters before entry). For example, Column 3 in Table 2 depicts the regression results for *lnPrice* when Southwest Airlines is the observed entrant. Holding all else constant, the mean airfare for legacy carrier incumbents is 14.7% lower, on average, in the quarter immediately following actual entry ($t_0 + 1$) relative to the excluded period (the ninth to twelfth quarters before entry).[16] Moreover, the estimates are mutually exclusive and the coefficients for the *Entry* variable are not additive.

To a certain extent, the entry time dummies in this paper resembles that in Goolsbee and Syverson (2008), which examines the effect of potential competition by Southwest Airlines on rivals' pricing strategies. They find that incumbent airlines decrease their mean airfare when they face potential competition with Southwest Airlines; thus, the incumbent price response occurs well before entry might occur. Goolsbee and Syverson (2008) estimate a two-way fixed effects model, incorporating twenty-five entry time dummies to estimate the effects of potential competition on mean airfare. Their event study approach examines the incumbents' mean airfare before, during, and after Southwest Airlines enters both endpoint airports of a route. However, the regression specification in this paper differs from that in Goolsbee and Syverson (2008) in two major ways. First, I focus on actual competition rather than potential competition, which is why I

[14] An alternative specification of three time dummies (one quarter before entry, the quarter of entry, and the quarter after entry) is implemented. The results of this robustness check, which is available upon request from the author, are quantitatively similar to the main results in this paper.

[15] http://www.swamedia.com/releases/Denver-San-Francisco-and-Philadelphia-Get-New-Destinations?l=en-US (last accessed on December 18, 2014)

[16] The percent change relative to the excluded period is calculated as exp(-0.159) - 1 = -0.147.

included only nine time dummies instead of twenty-five.[17] As such, I use a method that they employ in their study of potential competition to analyze the effect of actual entry. Second, I expand the analysis to include four low-cost carriers instead of just Southwest Airlines. Thus, I attempt to discern whether the entry effect exhibited by Southwest generally applies to other low-cost carriers.

In order to visualize the incumbent response to entry by a particular low-cost carrier, I create price paths based on the coefficients of the time dummies in the two-way fixed effects model. I log transform the regression estimates for the price paths in order to interpret the coefficients as the percent change in the dependent variable relative to the excluded time period. For example, the point in Figure 1(c) associated with the relative price change for legacy carrier incumbents' mean airfare one quarter after Southwest Airlines enters would be -0.147, instead of the actual regression estimate of -0.159. Entry occurs at time period 0 with negative time values signifying the quarters before actual entry and positive time values signifying the quarters after actual entry. The blue solid line is the log transformation of the point estimates from the model with the red dotted lines representing the 95% confidence interval. If prices are constant throughout (no statistically significant change in prices by incumbents), then this can be interpreted as incumbents not changing their prices in response to entry. If prices are less than zero and statistically significant after actual entry, then this provides evidence that incumbents decrease their prices in response to entry by a low-cost carrier.

[17]It is important to note the differences between the various types of competition in the airline industry. Suppose that Southwest Airlines operates at the San Diego International Airport (SAN) and the San Francisco International Airport (SFO). Suppose further that Southwest Airlines services the SAN-SFO route. Actual competition exists when two airlines service the same route in the same quarter. United Airlines is said to *actually compete* with Southwest Airlines if United also services the SAN-SFO route in the same quarter as Southwest Airlines. Now suppose that Southwest Airlines also operates at the Los Angeles International Airport (LAX), but does not service the SAN-LAX route. Potential competition exists when an airline operates at two airports but does not service the route linking both airports that is served by another airline. United Airlines *potentially competes* with Southwest Airlines if United services the SAN-LAX route in the same quarter that Southwest Airlines operates at both airports but does not service the SAN-LAX route. To be sure, it is possible for an airline to never actually compete on a route with a rival despite facing potential competition in prior time periods.

4.2 Effect of Entry on Mean Airfare

The theoretical prediction for how incumbent firms should respond to entry by a rival firm is ambiguous. On the one hand, the incumbent could succumb to the competitive effect, in which incumbents decrease their prices after entry occurs due to the reduction in their respective demand caused by the influx of substitutes. Conversely, entry could induce incumbents into the displacement effect, in which prices actually increase so that they could exploit the switching costs inherent in the brand-loyal market segment. I start to analyze which of these effects dominates in the airline industry by examining how legacy carrier incumbents' mean airfare changes in response to actual entry by a low-cost carrier.

Table 2 reports the regression results for each low-cost carrier entrant using the natural log of mean airfare as the dependent variable. Gerardi and Shapiro (2009) find that an increase in competition, measured by the negative value of the natural log of the Herfindahl Index, leads to lower airfares. Moreover, Ciliberto and Schenone (2012) determine that legacy carriers decrease their airfares while under Chapter 11 bankruptcy protection. The estimated coefficients for both the $-lnHERF$ and the $Bankruptcy$ variables are consistently negative and statistically significant for each of the four low-cost carriers. Sutton (1991) questions whether concentrated industries lead to less price competition as predicted by theoretical industrial organization models. To that extent, the results shed light on the relationship between airfares and market concentration at the route-level.[18] Namely, low cost carrier entry leads to tougher price competition. By controlling for these factors along with the carrier-route and year-quarter fixed effects, I am able to analyze the entry effects of low-cost carriers on incumbents' mean airfare through the $Entry$ time dummies.

Figure 1 illustrates the price paths for legacy carrier incumbents in response to entry by either AirTran Airways (Figure 1(a)), JetBlue Airways (Figure 1(b)), Southwest Airlines (Figure 1(c)),

[18] Although I elect to use the negative value of the natural log of route-level Herfindahl Index as the measure for competition, I check for the robustness of this specification by using two alternative competition measures: (1) the natural log of the total number of competitors and (2) the number of legacy carriers and the number of low-cost carriers servicing a route. The results of these robustness checks are qualitatively similar to the key results presented in the paper and are available upon request from the author.

and Spirit Airlines (Figure 1(d)). These price paths graph out the log transformation of the time dummies from the regression results summarized in Table 2. A separate regression is conducted for each entrant, resulting in an incumbent price path for each of the four low-cost carrier entrants. Morrison (2001) and Vowles (2001) both find that incumbents significantly decrease their prices the quarter following actual entry by Southwest Airlines. Thus, I focus my analysis on the incumbent response in the subsequent quarter after actual entry occurs. However, I expand their analysis to examine the price effect induced by entry by other low-cost carriers.

Each price path in Figure 1 shows the percentage price change relative to the excluded period (the ninth to twelfth period before entry) for the four quarters before entry to the four quarters after entry. According to Figure 1(c), incumbents significantly change their average prices when Southwest Airlines actually enters the route. In fact, the blue solid line shows that incumbents' prices decrease 14.7% on average in the quarter following entry by Southwest Airlines. Based on the 95% confidence intervals (the red dotted lines), Figure 1(c) shows that this decrease is statistically significant. This key result corroborates the previous findings in the literature. Namely, incumbents decrease their prices in response to entry by Southwest Airlines. However, I want to determine whether this effect is induced by other low-cost carrier entrants.

Further examination of the other price paths in Figure 1 shows that incumbents generally tend to decrease their mean airfares following entry by other low-cost carriers. Southwest Airlines exhibits the largest average entry effect, with the aforementioned result of inducing incumbents to decrease prices by 14.7%, on average, the quarter after actual entry. Entry by AirTran Airways, JetBlue Airways, and Spirit Airlines invokes legacy carrier incumbents to significantly decrease their prices by 8.1%, 9.5%, and 6.5% respectively. Thus, each low-cost carrier induced incumbents to decrease their prices after actual entry, which provides evidence in support of the dominance of the competitive effect.

The existing literature focuses particularly on the strong entry effect of Southwest Airlines. In particular, Morrison (2001) and Vowles (2001) both identify the Southwest Effect, in which incumbents reduce their price in response to entry by Southwest Airlines. Thus, it is not surprising that the results presented in this paper suggest that incumbent airlines decrease their average airfares in response to entry by Southwest Airlines. However, entry by other low-cost airlines over the past three decades has dramatically expanded their route network and their prominence in the airline industry. The results suggest that entry by AirTran Airways, JetBlue Airways, and Spirit Airlines leads to a similar, yet weaker effect on average airfares as entry by Southwest Airlines. The upshot is that the Southwest Effect should not be considered as just a special case relevant to one specific airline. Rather, the entry effect pertains to low-cost carriers in general.[19]

4.3 Effect of Entry on 10th Percentile Airfare and 90th Percentile Airfare

The analysis pertaining to the dominance of the competitive effect over the displacement effect can be extended to other points of the price distribution. In particular, incumbent firms can respond to entry by rival firms by altering their 10th percentile price and 90th percentile price. In the airline industry, the 10th percentile airfare can be characterized as discount tickets, whereas the 90th percentile airfare describes full-fare prices. If the competitive effect truly dominates the airline industry, then legacy carrier incumbents would respond to entry by low-cost carriers by lowering both their 10th percentile and 90th percentile airfares. Indeed, Gerardi and Shapiro (2009) find that increased competition puts downward pressure on the tails of the price distribution. On the other hand, incumbents decreasing their 10th percentile airfare, while increasing their 90th percentile airfare would be associated with the displacement effect. As mentioned in Borenstein and Rose (1994), an increase in competition can induce incumbents to decrease their 10th percentile airfare to attract price-sensitive consumers, while increasing their 90th percentile airfare to exploit their brand-loyal consumers. By conducting a similar regression analysis and constructing price paths similar to the ones in Section 4.2, I can determine how legacy carrier incumbents change their 10th and 90th percentile airfares in response to increased competition from a low-cost carrier entrant.

[19] As a robustness check, I pool low-cost carriers together and analyze the incumbent response to entry by all low-cost carriers. The results are qualitatively similar and are available upon request from the author.

Tables 3 and 4 report the regression results for each low-cost carrier entrant using the natural log of 10th percentile airfare and 90th percentile airfare as the dependent variable, respectively. As with the results in Table 2, legacy carriers decrease their 10th percentile and 90th percentile prices on routes with a lower level of concentration and whenever they are bankrupt. The estimates for the *Entry* time dummies in Tables 3 and 4 are used to construct the price paths in Figures 2 and 3, respectively.

Figure 2 shows that legacy carrier incumbents slash their 10th percentile prices following entry. In the quarter after Southwest Airlines actually enters a route, legacy carrier incumbents decreased their 10th percentile prices by 10.8%, on average, relative to the excluded period (the ninth to twelfth quarter before entry). Other low-cost entrants induced similar effects, with legacy carrier incumbents dropping prices by an average of 5.0%, 7.4%, and 4.9% when AirTran Airways, JetBlue Airways, and Spirit Airlines entered the route, respectively. These results suggest that legacy carrier incumbents significantly decrease their discount prices in response to entry by a low-cost carrier.

Figure 3 indicates legacy carrier incumbents respond to low-cost carrier entry by decreasing their full fare prices, on average. Southwest Airlines induces legacy carrier incumbents to decrease their 90th percentile prices by 17.4%, while legacy carriers decreased their 90th percentile price by 8.4%, 10.9%, and 6.8% in the quarter after actual entry by AirTran Airways, JetBlue Airways, and Spirit Airlines, respectively. Thus, legacy carrier incumbents respond to entry by low-cost carriers by decreasing airfares at both tails of the price distribution, which is evidence that the competitive effect truly dominates in the U.S. airline industry. These results also support the findings in Gerardi and Shapiro (2009) although I focus on a different mechanism of increased competition.

Figure 4 combines the trajectories for the 10th percentile airfares (dotted light blue line), mean airfares (solid blue light), and 90th percentile airfares (dashed dark blue line) for each low-cost carrier entrant. Although airfares seem to decrease at the mean and tails of the price distribution, the 10th percentile airfare tend to fall by a smaller percentage than mean airfares, while the 90th percentile airfare experience a larger percent decrease than mean airfares. Thus, the shape of the incumbent's price distribution might be altered due to changes in the incumbent airline's pricing strategy following entry by low-cost carrier, which is examined in the following subsection.

4.4 Effect of Entry on the Gini Coefficient and Standard Deviation

Both Borenstein and Rose (1994) and Gerardi and Shapiro (2009) study the impact of competition on price dispersion in the U.S. airline industry. Borenstein and Rose (1994) use cross-sectional data to conclude that price dispersion is higher for routes that are less concentrated. The intuition is that airlines will more drastically decrease 10th percentile airfares compared to 90th percentile airfares when experiencing more competition, leading to a higher level of price dispersion. In contrast, Gerardi and Shapiro (2009) use panel data to analyze this same research question in a more dynamic setting. They find that an increase in the number of rival airlines will drive airlines to decrease their 90th percentile airfares by more than their 10th percentile prices, causing price dispersion to decrease. Instead of measuring competition by the route-level Herfindahl Index or the number of competitors, I use entry by low-cost carriers as an indication that competition increases and study the entry effect on price dispersion. As such, this paper does not seek to refute the results in either Borenstein and Rose (1994) or Gerardi and Shapiro (2009), but rather to add to their discussion on the effect of competition on price dispersion. Thus, the novelty of this paper lies not in the use of percentile estimates, but rather in the use of entry to study how incumbent airlines' price dispersion differs over time and how this effect on price dispersion generally applies to low-cost carriers.

As with Borenstein and Rose (1994) and Gerardi and Shapiro (2009), I use the Gini coefficient as a measure for price dispersion. The lower the value of the Gini coefficient, the smaller the degree of price dispersion in a market. However, I analyze the standard deviation of airfares as another metric for price dispersion in the sense that a reduction in the standard deviation of airfares implies a decrease in price dispersion. Tables 5 and 6 report the regression results for each low-cost carrier entrant using the log-odds ratio of the Gini coefficient and the natural log of standard deviation of airfares as the dependent variable, respectively. Figures 5 and 6, which respectively plot the log transformation of the *Entry* variables in Tables 5 and 6, can be interpreted as the evolution of the incumbent's price dispersion in the entered route over time. The results imply, that for a given amount of market concentration, entry by low-cost carriers matter for pricing and price dispersion.

Figure 5 shows that the Gini coefficient for legacy carrier incumbent's prices decreases in response to entry by a low-cost carrier. As with the analysis using airfares, the percentage change in the Gini coefficient is relative to the excluded period (the ninth to twelfth quarters before entry). Recall that legacy carrier incumbents decrease their 10th percentile airfare, mean airfare, and 90th percentile airfare in response to entry by a low-cost carrier. Since legacy carrier incumbents decrease their 90th percentile airfare by more than their mean airfare, which in turn decreases by more than their 10th percentile prices, the Gini coefficient ultimately decreases as well. However, the figure for Spirit Airlines is an anomaly, perhaps because Spirit Airlines entered a relatively small number of routes compared to other low-cost carriers. Although the results in Figure 5(d) is noisy, incumbent airlines clearly decrease their airfares in response to entry by Spirit Airlines as illustrated in Figure 4(d). Thus, analyzing the standard deviation of airfares could provide additional insight into the effect of entry by Spirit Airlines and other low-cost carriers on price dispersion. Figure 6 illustrates that the standard deviation of airfares decreases, which occurs due to the compression of the price distribution that naturally follows from a reduction in the mean airfare and the tails of the distribution. Therefore, price dispersion generally decreases once airlines face stronger competition in the form of entry by low-cost carriers, which is consistent with the conclusions made in Gerardi and Shapiro (2009).

5 Conclusion

This paper studies the incumbent response to entry by low-cost carriers. The results suggest that legacy carrier incumbents tend to decrease their mean airfare following entry by any of the four low-cost carriers studied in this paper: AirTran Airways, JetBlue Airways, Southwest Airlines, and Spirit Airlines. By separately analyzing the incumbent response to each of these low-cost carriers, I am able to discern that the strong entry effect attributed to Southwest Airlines in the existing literature applies to these other low-cost carriers as well. Thus, the so-called Southwest Effect can be more broadly described as a Low-Cost Carrier Effect.

There is burgeoning evidence that legacy carriers sometimes engage in a price matching strategy. Escobari, Rupp, and Meskey (2013) find that legacy carriers match the airfares of rival airlines and that price deviations are smaller when airfares are higher. Edlin and Farrell (2004) discuss how the U.S. Department of Justice determined that American Airlines in particular responded to entry by low-cost carriers by initially matching the entrant's airfares. Future research can investigate the pricing strategy of the low-cost carrier entrant and determine whether legacy carrier incumbents' lower post-entry airfares discussed in this paper end up matching the price of low-cost carrier entrants.

Low-cost carrier incumbents may respond differently to entry than legacy carrier incumbents, but there are currently not enough observations of low-cost carriers entering routes serviced by other low-cost carriers to garner a comprehensible result. More data can be collected as low-cost carriers continue to expand their route network. Hopefully, future work can shed light on how low-cost carrier incumbents respond to entry by rival low-cost carriers.

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Tables

Table 1: Summary Statistics

Variable	Definition	Mean (Std. Dev.)
$Price_{ijt}$	Average one-way market fare for carrier i	210.42
	on route j in time period t	(66.87)
$Gini_{ijt}$	Gini coefficient of carrier i's prices	0.250
	on route j in time period t	(0.073)
$Distance_j$	One-way distance (in miles)	1,193.42
	between the endpoints of route j	(640.23)
$Passengers_{ijt}$	Number of passengers for carrier i	1,200.31
	on route j in time period t	(642.07)
$HERF_{jt}$	Herfindahl Index for route j	0.498
	in time period t	(0.242)
$Bankrupt_{it}$	Indicator variable for carrier i	0.106
	in bankruptcy in time period t	(0.307)
Airports	Number of airports in the sample	134
Routes	Number of routes in the sample	15,816
N	Number of observations	2,008,446

Table 2: Incumbent Price Response to Entry
(Dependent Variable: *lnPrice*)

Entrant:	(1) AirTran Airways	(2) JetBlue Airways	(3) Southwest Airlines	(4) Spirit Airlines
$-lnHERF$	-0.092^{**}	-0.093^{**}	-0.092^{**}	-0.093^{**}
	(0.001)	(0.001)	(0.001)	(0.001)
$Bankrupt$	-0.026^{**}	-0.026^{**}	-0.025^{**}	-0.027^{**}
	(0.001)	(0.001)	(0.001)	(0.001)
$Entry_{t_0-4}$	0.026^{**}	-0.020^{**}	0.017^{**}	0.005
	(0.003)	(0.006)	(0.003)	(0.011)
$Entry_{t_0-3}$	0.018^{**}	-0.019^{**}	0.024^{**}	-0.009
	(0.003)	(0.007)	(0.003)	(0.011)
$Entry_{t_0-2}$	0.012^{**}	-0.007	0.014^{**}	-0.017
	(0.003)	(0.006)	(0.003)	(0.012)
$Entry_{t_0-1}$	0.000	-0.006	-0.001	-0.059^{**}
	(0.003)	(0.007)	(0.003)	(0.013)
$Entry_{t_0}$	-0.052^{**}	-0.066^{**}	-0.109^{**}	-0.027
	(0.004)	(0.007)	(0.004)	(0.015)
$Entry_{t_0+1}$	-0.084^{**}	-0.100^{**}	-0.159^{**}	-0.067^{**}
	(0.004)	(0.007)	(0.004)	(0.017)
$Entry_{t_0+2}$	-0.091^{**}	-0.101^{**}	-0.163^{**}	-0.057^{**}
	(0.004)	(0.007)	(0.004)	(0.018)
$Entry_{t_0+3}$	-0.090^{**}	-0.109^{**}	-0.170^{**}	-0.104^{**}
	(0.004)	(0.008)	(0.004)	(0.019)
$Entry_{t_0+4}$	-0.087^{**}	-0.103^{**}	-0.161^{**}	-0.078^{**}
	(0.004)	(0.007)	(0.004)	(0.018)
N	2,008,446	2,008,446	2,008,446	2,008,446

Note: This table presents the results for the two-way fixed effects regression of the natural log of legacy carrier incumbent's mean airfare in response to entry by four low-cost carriers. The *entry* variables are the lagged/forward time dummies, where $Entry_{t_0}$ is the quarter of entry. Observations are at the carrier-route-year-quarter level. Constant term, carrier-route fixed effects, and year-quarter fixed effects suppressed. Standard errors, which are clustered by carrier-route, are reported in parentheses.
* indicates significance at 5% level.
** indicates significance at 1% level.

Table 3: Incumbent Price Response to Entry
(Dependent Variable: $lnP10$)

	(1)	(2)	(3)	(4)
Entrant:	AirTran Airways	JetBlue Airways	Southwest Airlines	Spirit Airlines
$-lnHERF$	-0.058^{**}	-0.059^{**}	-0.058^{**}	-0.059^{**}
	(0.001)	(0.001)	(0.001)	(0.001)
$Bankrupt$	-0.038^{**}	-0.038^{**}	-0.036^{**}	-0.038^{**}
	(0.001)	(0.001)	(0.001)	(0.001)
$Entry_{t_0-4}$	0.004	0.001	0.017^{**}	0.026^{*}
	(0.003)	(0.006)	(0.003)	(0.010)
$Entry_{t_0-3}$	-0.011^{**}	0.000	0.005	-0.008
	(0.004)	(0.006)	(0.003)	(0.012)
$Entry_{t_0-2}$	0.004	-0.004	0.009^{**}	-0.009^{**}
	(0.003)	(0.007)	(0.003)	(0.013)
$Entry_{t_0-1}$	-0.012^{**}	-0.009	-0.005	-0.039
	(0.003)	(0.008)	(0.003)	(0.014)
$Entry_{t_0}$	-0.037^{**}	-0.059^{**}	-0.087^{**}	-0.020
	(0.003)	(0.007)	(0.004)	(0.013)
$Entry_{t_0+1}$	-0.051^{**}	-0.077^{**}	-0.114^{**}	-0.050^{**}
	(0.003)	(0.007)	(0.004)	(0.014)
$Entry_{t_0+2}$	-0.046^{**}	-0.075^{**}	-0.113^{**}	-0.045^{**}
	(0.003)	(0.006)	(0.004)	(0.015)
$Entry_{t_0+3}$	-0.056^{**}	-0.077^{**}	-0.121^{**}	-0.056^{**}
	(0.004)	(0.007)	(0.004)	(0.015)
$Entry_{t_0+4}$	-0.058^{**}	-0.071^{**}	-0.122^{**}	-0.042^{**}
	(0.004)	(0.006)	(0.004)	(0.014)
N	2,008,446	2,008,446	2,008,446	2,008,446

Note: This table presents the results for the two-way fixed effects regression of the natural log of legacy carrier incumbent's 10th percentile airfare in response to entry by four low-cost carriers. The $entry$ variables are the lagged/forward time dummies, where $Entry_{t_0}$ is the quarter of entry. Observations are at the carrier-route-year-quarter level. Constant term, carrier-route fixed effects, and year-quarter fixed effects suppressed. Standard errors, which are clustered by carrier-route, are reported in parentheses.
* indicates significance at 5% level.
** indicates significance at 1% level.

Table 4: Incumbent Price Response to Entry
(Dependent Variable: $lnP90$)

	(1)	(2)	(3)	(4)
Entrant:	AirTran Airways	JetBlue Airways	Southwest Airlines	Spirit Airlines
$-lnHERF$	-0.114^{**}	-0.114^{**}	-0.113^{**}	-0.115^{**}
	(0.002)	(0.002)	(0.002)	(0.002)
$Bankrupt$	-0.023^{**}	-0.023^{**}	-0.022^{**}	-0.024^{**}
	(0.001)	(0.001)	(0.001)	(0.001)
$Entry_{t_0-4}$	0.038^{**}	-0.036^{**}	0.022^{**}	0.014
	(0.005)	(0.009)	(0.046)	(0.021)
$Entry_{t_0-3}$	0.032^{**}	-0.031^{**}	0.046^{**}	-0.016
	(0.005)	(0.011)	(0.005)	(0.020)
$Entry_{t_0-2}$	0.022^{**}	-0.012	0.022^{**}	-0.004
	(0.005)	(0.010)	(0.005)	(0.021)
$Entry_{t_0-1}$	0.004	-0.008	0.011^{*}	-0.039
	(0.005)	(0.011)	(0.005)	(0.023)
$Entry_{t_0}$	-0.050^{**}	-0.061^{**}	-0.121^{**}	-0.014
	(0.006)	(0.011)	(0.006)	(0.026)
$Entry_{t_0+1}$	-0.088^{**}	-0.115^{**}	-0.191^{**}	-0.070^{*}
	(0.006)	(0.012)	(0.006)	(0.029)
$Entry_{t_0+2}$	-0.109^{**}	-0.118^{**}	-0.201^{**}	-0.040
	(0.006)	(0.012)	(0.006)	(0.032)
$Entry_{t_0+3}$	-0.100^{**}	-0.130^{**}	-0.204^{**}	-0.133^{**}
	(0.006)	(0.012)	(0.006)	(0.031)
$Entry_{t_0+4}$	-0.095^{**}	-0.120^{**}	-0.197^{**}	-0.096^{**}
	(0.006)	(0.011)	(0.006)	(0.030)
N	2,008,446	2,008,446	2,008,446	2,008,446

Note: This table presents the results for the two-way fixed effects regression of the natural log of legacy carrier incumbent's 90th percentile airfare in response to entry by four low-cost carriers. The $entry$ variables are the lagged/forward time dummies, where $Entry_{t_0}$ is the quarter of entry. Observations are at the carrier-route-year-quarter level. Constant term, carrier-route fixed effects, and year-quarter fixed effects suppressed. Standard errors, which are clustered by carrier-route, are reported in parentheses.
* indicates significance at 5% level.
** indicates significance at 1% level.

Table 5: Incumbent Price Response to Entry
(Dependent Variable: $loddGini$)

	(1)	(2)	(3)	(4)
Entrant:	AirTran Airways	JetBlue Airways	Southwest Airlines	Spirit Airlines
$-lnHERF$	-0.033^{**}	-0.033^{**}	-0.032^{**}	-0.033^{**}
	(0.002)	(0.002)	(0.002)	(0.002)
$Bankrupt$	0.012^{**}	0.013^{**}	0.013^{**}	0.013^{**}
	(0.001)	(0.001)	(0.001)	(0.001)
$Entry_{t_0-4}$	0.024^{**}	-0.008	-0.007	0.019
	(0.005)	(0.010)	(0.005)	(0.018)
$Entry_{t_0-3}$	0.030^{**}	-0.024^{*}	0.026^{**}	0.038^{*}
	(0.005)	(0.010)	(0.005)	(0.017)
$Entry_{t_0-2}$	0.010	-0.016	0.008	0.020
	(0.005)	(0.010)	(0.005)	(0.020)
$Entry_{t_0-1}$	0.023^{**}	0.002	0.011^{*}	0.025
	(0.005)	(0.011)	(0.006)	(0.020)
$Entry_{t_0}$	0.004	0.005	-0.002	0.027
	(0.006)	(0.011)	(0.006)	(0.021)
$Entry_{t_0+1}$	-0.019^{**}	-0.010	-0.029^{**}	0.012
	(0.006)	(0.012)	(0.006)	(0.024)
$Entry_{t_0+2}$	-0.037^{**}	-0.027^{*}	-0.035^{**}	0.040
	(0.006)	(0.012)	(0.006)	(0.024)
$Entry_{t_0+3}$	-0.024^{**}	-0.024	-0.031^{**}	-0.014
	(0.006)	(0.012)	(0.006)	(0.026)
$Entry_{t_0+4}$	-0.017^{**}	-0.034^{**}	-0.031^{**}	-0.020
	(0.006)	(0.012)	(0.006)	(0.025)
N	2,008,446	2,008,446	2,008,446	2,008,446

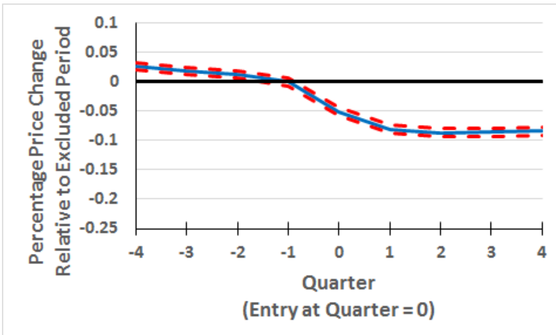
Note: This table presents the results for the two-way fixed effects regression of the log-odds ratio of the legacy carrier incumbent's Gini coefficient in response to entry by four low-cost carriers. The $entry$ variables are the lagged/forward time dummies, where $Entry_{t_0}$ is the quarter of entry. Observations are at the carrier-route-year-quarter level. Constant term, carrier-route fixed effects, and year-quarter fixed effects suppressed. Standard errors, which are clustered by carrier-route, are reported in parentheses.
* indicates significance at 5% level.
** indicates significance at 1% level.

Table 6: Incumbent Price Response to Entry
(Dependent Variable: *lnSD*)

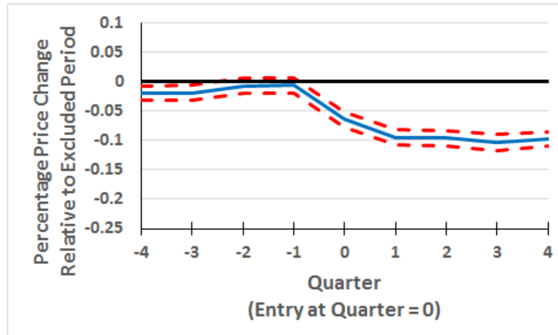
Entrant:	(1) AirTran Airways	(2) JetBlue Airways	(3) Southwest Airlines	(4) Spirit Airlines
$-lnHERF$	-0.095^{**}	-0.095^{**}	-0.094^{**}	-0.095^{**}
	(0.002)	(0.002)	(0.002)	(0.002)
Bankrupt	-0.013^{**}	-0.012^{**}	-0.011^{**}	-0.013^{**}
	(0.002)	(0.002)	(0.002)	(0.002)
$Entry_{t_0-4}$	0.037^{**}	-0.013	0.007	0.034
	(0.006)	(0.012)	(0.006)	(0.021)
$Entry_{t_0-3}$	0.034^{**}	-0.026^{*}	0.034^{**}	0.049^{*}
	(0.006)	(0.013)	(0.006)	(0.020)
$Entry_{t_0-2}$	0.015^{*}	-0.018	0.015^{*}	0.006
	(0.006)	(0.012)	(0.006)	(0.021)
$Entry_{t_0-1}$	0.019^{**}	-0.003	0.007	-0.021
	(0.006)	(0.013)	(0.006)	(0.021)
$Entry_{t_0}$	-0.037^{**}	-0.049^{**}	-0.088^{**}	0.001
	(0.007)	(0.013)	(0.007)	(0.026)
$Entry_{t_0+1}$	-0.082^{**}	-0.085^{**}	-0.139^{**}	-0.023
	(0.007)	(0.015)	(0.007)	(0.027)
$Entry_{t_0+2}$	-0.098^{**}	-0.098^{**}	-0.146^{**}	0.000
	(0.007)	(0.014)	(0.007)	(0.027)
$Entry_{t_0+3}$	-0.095^{**}	-0.100^{**}	-0.155^{**}	-0.049
	(0.007)	(0.015)	(0.007)	(0.030)
$Entry_{t_0+4}$	-0.089^{**}	-0.115^{**}	-0.148^{**}	-0.065^{*}
	(0.007)	(0.014)	(0.007)	(0.029)
N	2,008,446	2,008,446	2,008,446	2,008,446

Note: This table presents the results for the two-way fixed effects regression of the natural log of the legacy carrier incumbent's standard deviation of airfares in response to entry by four low-cost carriers. The *entry* variables are the lagged/forward time dummies, where $Entry_{t_0}$ is the quarter of entry. Observations are at the carrier-route-year-quarter level. Constant term, carrier-route fixed effects, and year-quarter fixed effects suppressed. Standard errors, which are clustered by carrier-route, are reported in parentheses.
* indicates significance at 5% level.
** indicates significance at 1% level.

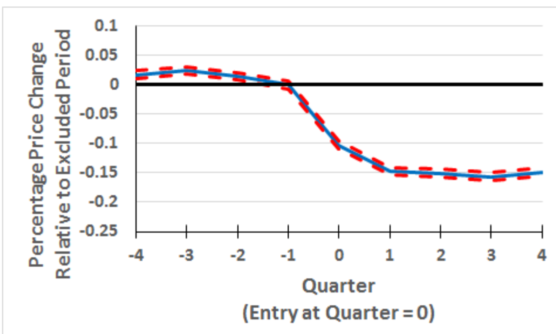
Figures



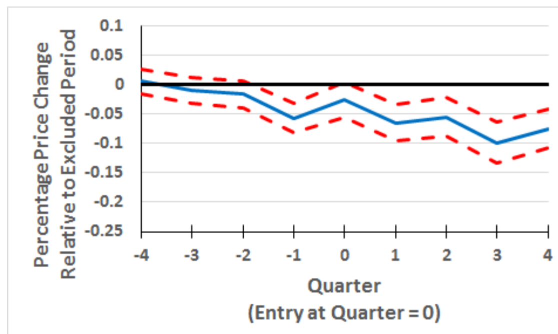
(a) Entrant: AirTran Airways



(b) Entrant: JetBlue Airways

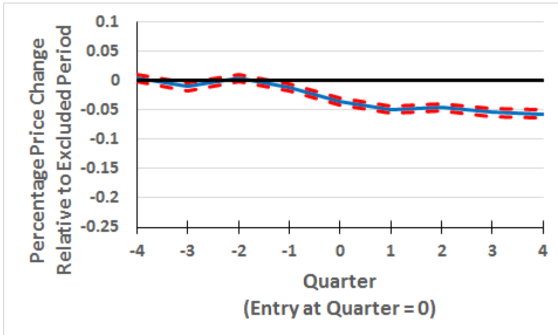


(c) Entrant: Southwest Airlines

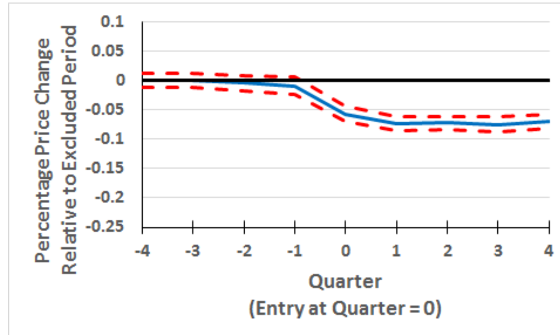


(d) Entrant: Spirit Airlines

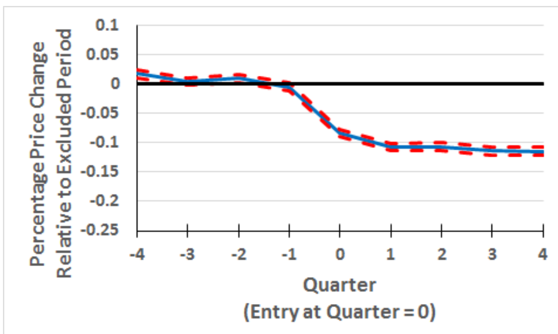
Figure 1: Incumbent Response to Entry: Mean Airfare



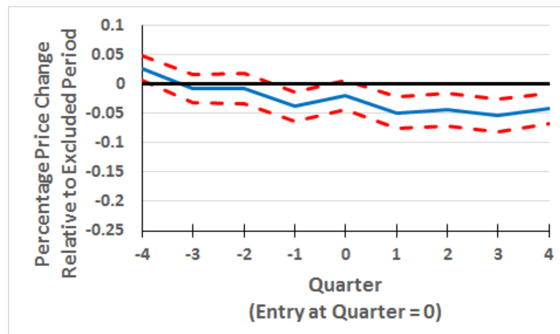
(a) Entrant: AirTran Airways



(b) Entrant: JetBlue Airways

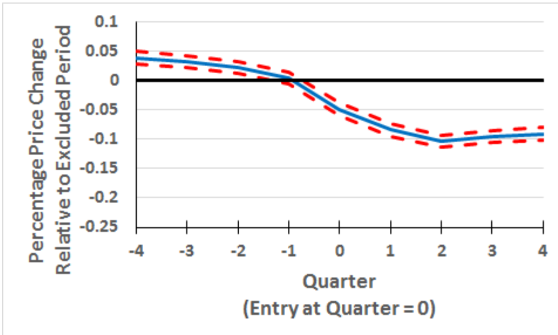


(c) Entrant: Southwest Airlines

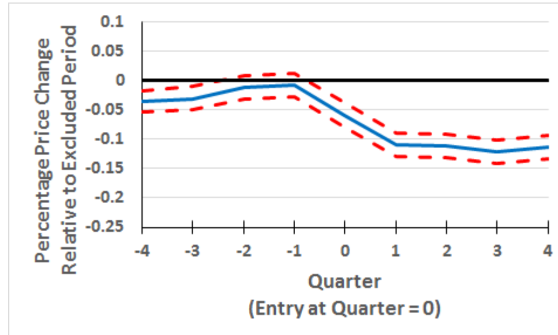


(d) Entrant: Spirit Airlines

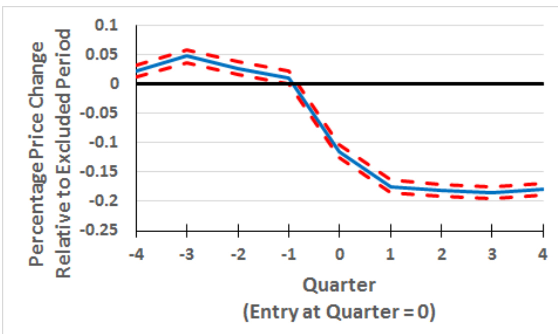
Figure 2: Incumbent Response to Entry: 10th Percentile Airfare



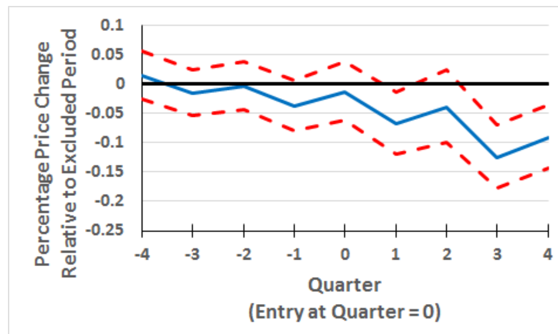
(a) Entrant: AirTran Airways



(b) Entrant: JetBlue Airways

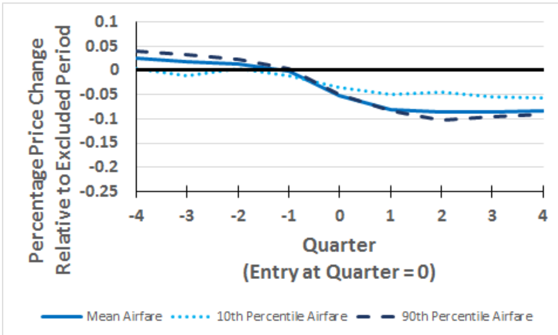


(c) Entrant: Southwest Airlines

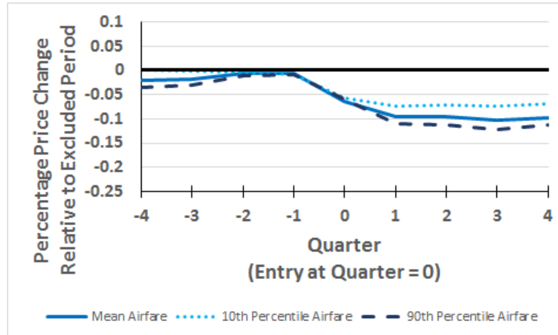


(d) Entrant: Spirit Airlines

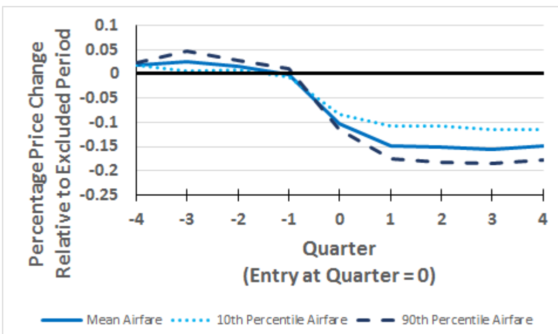
Figure 3: Incumbent Response to Entry: 90th Percentile Airfare



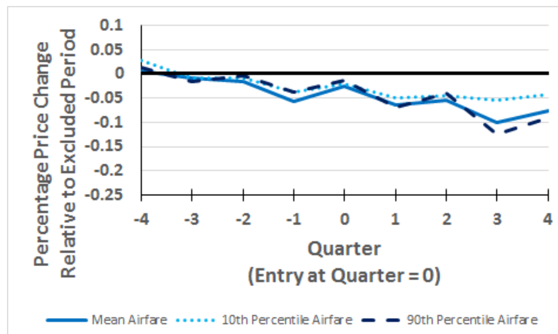
(a) Entrant: AirTran Airways



(b) Entrant: JetBlue Airways

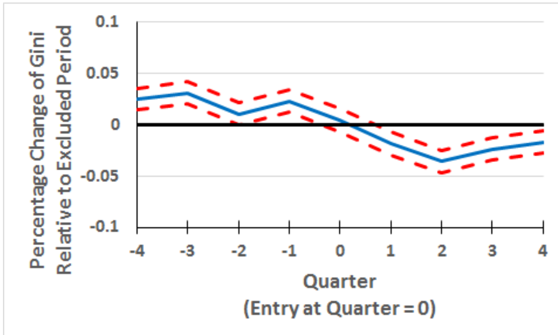


(c) Entrant: Southwest Airlines

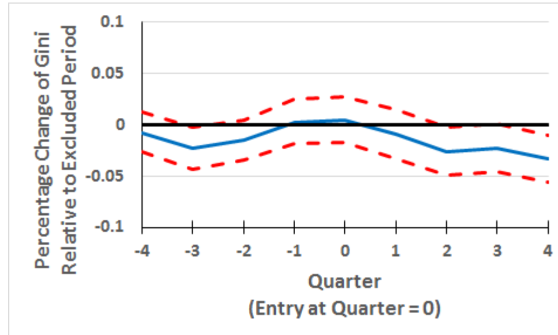


(d) Entrant: Spirit Airlines

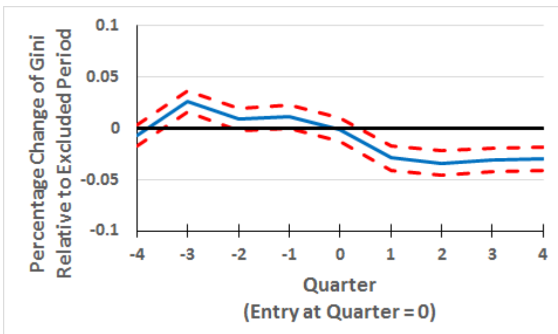
Figure 4: Incumbent Response to Entry: Mean, 10th Percentile, and 90th Percentile Airfares



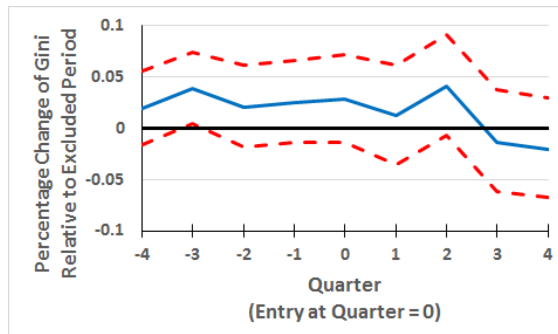
(a) Entrant: AirTran Airways



(b) Entrant: JetBlue Airways

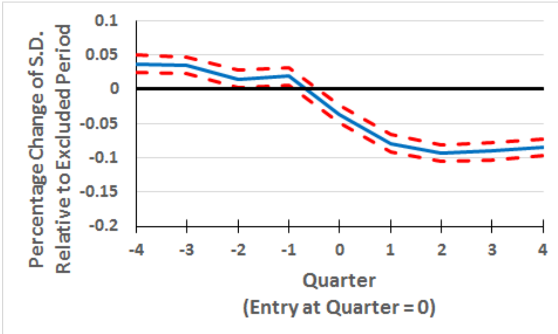


(c) Entrant: Southwest Airlines

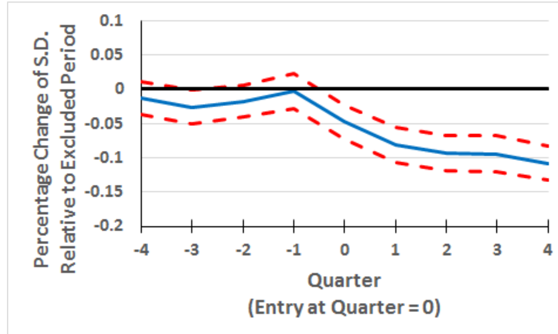


(d) Entrant: Spirit Airlines

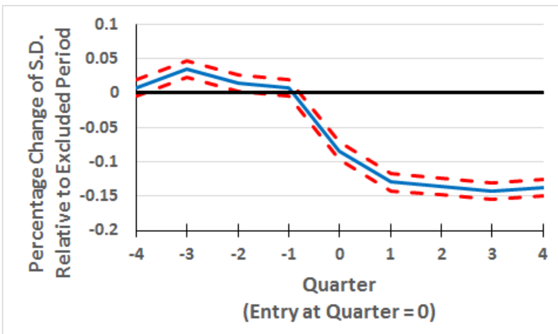
Figure 5: Incumbent Response to Entry: Gini Coefficient



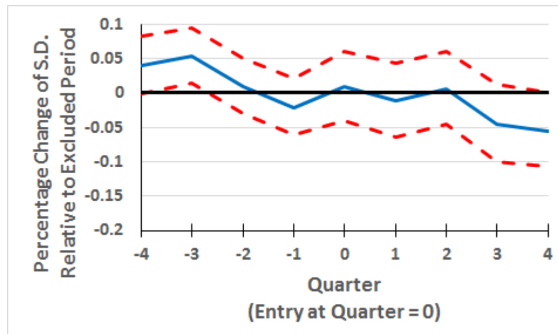
(a) Entrant: AirTran Airways



(b) Entrant: JetBlue Airways



(c) Entrant: Southwest Airlines



(d) Entrant: Spirit Airlines

Figure 6: Incumbent Response to Entry: Standard Deviation