Legacy Carriers' Use of Regional Airlines: Competition or Entry Deterrence?*

Kerry M. Tan†

October 2015

Abstract

This paper investigates whether outsourcing by legacy carriers to regional airlines is pro-competitive or anti-competitive. Legacy carriers are more inclined to switch to regional airlines on routes where a low-cost carrier exists, subsequently decreasing their average airfare. However, low-cost carriers are not effectively deterred from entering routes where a regional airline is present. The results refute the notion made in the existing literature that regional airlines can serve as an effective barrier to entry to low-cost carriers, rather suggesting that legacy carriers exploit the more cost-efficient regional airlines in order to lower prices and better compete with low-cost carriers.

JEL classifications: L93, L11

*I would like to thank Matt Lewis, Jim Peck, Huanxing Yang, Stephen J.K. Walters, as well as seminar participants at The Ohio State University, the Southern Economic Association Annual Meeting, and the International Industrial Organization Conference for their helpful suggestions and comments. All errors are my own.

†Economics Department, Loyola University Maryland, 4501 N. Charles St, Baltimore, MD 21204

1 Introduction

Legacy carriers have recently become much more reliant on regional airlines to provide service for passengers within their route network. The number of passengers flown by regional airlines within the United States has increased from 6.56 million in 1998 to 36.5 million in 2009, largely due to growth in outsourcing by legacy carriers during this time period. Under these arrangements, planes are owned by the regional airlines but are painted to resemble the legacy carrier's fleet; flight crews are employed by the regional airline yet the legacy carrier is responsible for ticketing and operations at the airport. Such arrangements enable legacy carriers to benefit from regional airlines' lower labor costs. For example, Hirsch (2007) found that senior pilots and flight attendants at United Airlines make 80 percent more and 32 percent more, respectively, than their counterparts at regional airlines. This paper assesses the competitive effect of these outsourcing agreements between legacy carriers and their regional airline partners.

The use of regional airlines by legacy carriers can potentially have pro-competitive or anti-competitive effects. On the one hand, legacy carriers might outsource to regional airlines as a response to competitive pressure from low-cost carriers. With lower operating costs, legacy carriers may find it easier to decrease average airfare once they switch the operation of a route from their own fleet to a regional airline. Thus, the legacy carriers' growing use of regional airlines could be motivated by the desire to meet the price competition of existing low-cost carriers.

Alternatively, legacy carriers might use partnerships with regional airlines to facilitate a limit pricing strategy, in which legacy carriers decrease average airfares in order to erect a barrier to entry. From this perspective, outsourcing to regional airlines might be seen as a credible threat to commit to lower airfares and ultimately discourage a potential entrant from actually entering a route, which is clearly anti-competitive. Forbes and Lederman (2007) mention that outsourcing the operation of a route to a regional airline could serve as an effective barrier to entry to low-cost carriers. Their intuition follows an entry deterrence story, in which cost-efficient regional airlines could be utilized by legacy carriers as a signal to potential low-cost carrier entrants who would then find entry to be unprofitable. Moreover, Borenstein (1992) suggests that partnerships between legacy carriers and regional airlines can increase the cost of entry at airports where the two airlines connect. However, this paper is the first to formally analyze this conjecture.

My findings are largely consistent with the idea that regional airlines are used to help legacy carriers better compete with low-cost carriers. Legacy carriers typically lower average airfare once the switch to regional airlines occurs. Moreover, legacy carriers are more likely to start using regional airlines on routes where low-cost carriers are already present. In contrast, I find no evidence that the likelihood of entry by low-cost carriers is reduced where legacy carriers have outsourced to regional airlines. Therefore, the evidence is consistent with the notion that outsourcing is a competitive pricing response to current competition with low-cost carriers rather than an attempt to preclude future entry by prospective low-cost carriers.

2 Industry Structure

Before the Airline Deregulation Act of 1978, regional airlines operated as commuter airlines, servicing thin and short-haul routes. At the time, the Civil Aeronautics Board heavily regulated price and entry in the airline industry. Airlines were allowed to set high prices on long-haul routes, which cross-subsidized profit losses made on low-margin short-haul routes. Regional airlines, however, were exempt from regulation as long as their fleet contained planes below a certain size.[1] As such, they operated independently from the major airlines at the time.

After the airline industry became deregulated in 1978, legacy carriers altered their route structure by developing hub-and-spoke networks, in which passenger traffic is concentrated through certain airports in the United States. Under this system, legacy carriers have to decide whether to operate a route themselves or outsource to a regional airline. Although passengers purchase their ticket from the legacy carrier, the contracted regional airline supplies the aircrew and fleet used in the operation of the flight. Legacy carriers typically use regional airlines on short-haul routes linking a legacy carrier's spoke airport to its hub airport, and vice versa.

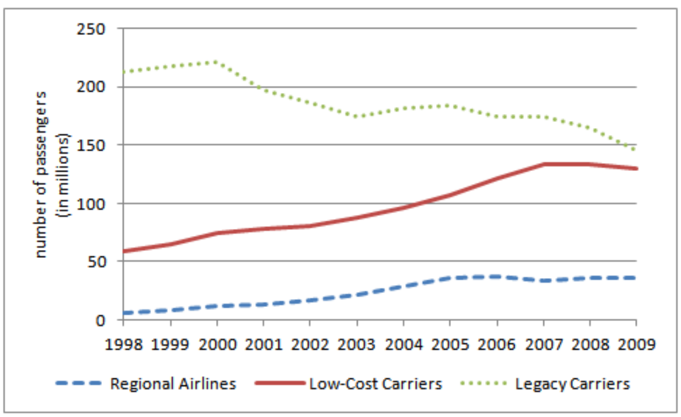

Figure 1: Number of Passengers Flown by Operating Carrier

The number of passengers is calculated based on whether the operating carrier was a regional airline, low-cost carrier, or legacy carrier. As such, the number of passengers is not determined by the ticketing carrier. For example, regional airlines would be credited for the number of passengers it flew on behalf of a legacy carrier. Legacy carriers only get credit for passengers who flew on flights that they operated themselves.

[1]The size limit effectively limited regional airlines to planes with 20 to 30 seats.

Legacy carriers have become more attracted to outsourcing to regional airlines in part because regional airlines have changed the type of aircraft they fly from turbo-props to regional jets, which have increased range, speed, and passenger capacity. As a result, the use of regional airlines by legacy carriers has drastically expanded over time as the total number of routes that legacy carriers outsourced to regional airlines increased from 1,917 in 1998 to 17,111 in 2009.[2] Figure 1 shows that 213 million and 6.56 million passengers flew on flights operated by legacy carriers and regional carriers, respectively, in 1998. This corresponds to a market share of 67.3% for legacy carriers and 2.1% for regional airlines. While the number of passengers flown by legacy carriers decreased to 146 million passengers (44.7% market share) in 2009, 36.4 million passengers (11.1% market share) flew with a regional airline operating on behalf of a legacy carrier, an increase of nearly 455% over the twelve year period.

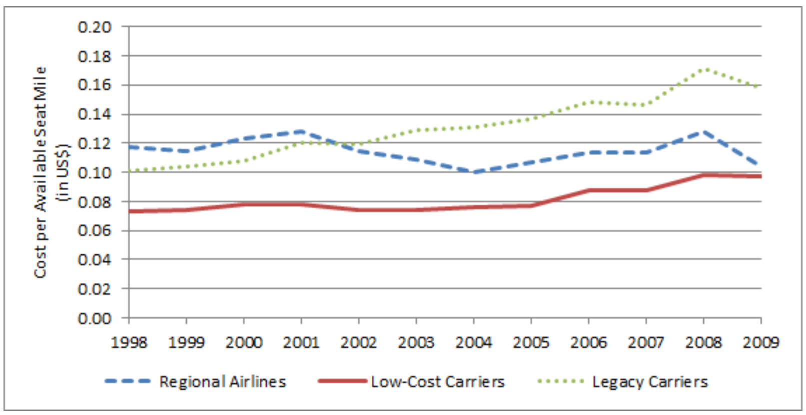

Figure 2: Cost per Available Seat Mile by Operating Carrier

The cost per available seat mile (CASM) is calculated based on whether the operating carrier was a regional airline, low-cost carrier, or legacy carrier. Source: Air Carrier Financial Reports (Form 41) from the U.S. Department of Transportation.

Breuckner and Pai (2009) analyze how the innovation of regional jets has increased service quality as measured by the frequency of flights. Regional airlines have steadily replaced their turboprop aircraft with more cost-efficient regional jets, leading to a lower cost per available seat per mile (CASM). Figure 2 illustrates the evolution of CASM[3] for regional airlines, low-cost carriers, and legacy carriers over time. By 2009, CASM for regional airlines approached the relatively

[2]Forbes and Lederman (2009 and 2010) explain how the decision for legacy carriers to outsource to an owned regional airline rather than an independent regional airline is affected by service quality-related motivations. Since I focus on the decision by legacy carriers to operate a route using its own fleet or any of its regional airline partners, I combine the statistics for independent and subsidiary regional airlines.

[3]CASM is calculated as operating expenses divided by available seat miles using the Air Carrier Financial Reports (Form 41) from the U.S. Department of Transportation.

low levels for low-cost carriers. Meanwhile, CASM for legacy carriers has steadily increased over time. The rise in the level of outsourcing by legacy carriers towards the use of regional airlines can be partly attributed to the increased cost advantage for regional airlines.

Since regional airlines have a more efficient cost structure, then perhaps legacy carriers could consider outsourcing all routes to the regional airlines and essentially have a franchisee/franchisor relationship with these regional airlines. However, scope clauses in labor union contracts between legacy carriers and its labor unions create a constraint on the amount of routes that the legacy carrier can outsource to the regional airline. As mentioned in Forbes and Lederman (2007), scope clauses typically take on one of two forms: 1) there is a cap on the total number of outsourcing by the network airlines to a regional airline partner or 2) the network airline must increase the amount of flights used by its own fleet by a pre-determined ratio for every increase in outsourced routes to regional airlines. These scope clauses effectively create a trade-off for the legacy carrier when they decide whether to switch to a regional airline as this would take away the opportunity of using that regional airline on a different route.

The rise of low-cost carriers is another outcome of a deregulated airline industry. Since deregulation made it easier for new airlines to enter the industry, start-up airlines emerged that found ways to lower the cost of available seat mile relative to that of legacy carriers. These low-cost carriers decreased the cost of operation by using a point-to-point network and a fleet consisting of the same aircraft.[4] Legacy carriers established low-cost "airline within an airline"[5] in order to counter the influx of new airlines, but they have all since been discontinued because they quickly became a financial burden to the legacy carrier.

As with regional airlines, low-cost carriers have experienced a remarkable growth in the number of passengers flown between 1998 and 2009. Figure 1 illustrates that the number of passengers flown by low-cost carriers has increased dramatically from 58.5 million (18.5% market share) in 1998 to 130 million (39.8% market share) in 2009. During this time period, there have been 940 instances of entry[6] by low-cost carriers into routes with a maximum distance of 1,500 miles, with AirTran Airways entering 424 routes, JetBlue Airways entering 136 routes, Southwest Airlines

[4]For example, Southwest Airlines operates Boeing aircraft exclusively, comprising of 614 Boeing 737 and 66 Boeing 717. Moreover, JetBlue's fleet of 194 planes include Airbus 320 and 321, as well as Embraer 190. On the other hand, legacy carriers operate a larger variety of planes manufactured by Boeing, Embraer, and Airbus. Low-cost carriers are able to reduce training and maintentance costs since their fleet is more concentrated on a fewer assortment of planes. Source: `http://finance.yahoo.com/news/low-cost-carrier-strategies-maintain-225005754.html`

[5]Examples include Continental Lite (Continental Airlines), Song (Delta Air Lines), and Ted (United Airlines).

[6]Each instance is defined by entry into a one-way airport pair. For example, when Southwest started operating the route between Detroit Metro Airport and Philadelphia International Airport in 2004, two routes are entered: the route from Philadelphia to Detroit, and the route from Detroit to Philadelphia.

entering 322 routes, and Spirit Airlines entering 58 routes. The expansion of the low-cost carrier's route network largely explains their recent growth and their emergence as a major influence in the U.S. airline industry. This paper studies how the growing use of regional airlines by legacy carriers has impacted competition in the airline industry, particularly between legacy carriers and low-cost carriers.

3 Data

In order to investigate how legacy carriers use regional airlines to better compete with low-cost carriers, I use data from three main sources. The main dataset used in this paper is the Airline Origin and Destination Survey (DB1B), which is published quarterly by the Bureau of Transportation Statistics. It is a ten percent survey of domestic air travel and contains data on the origin, destination, non-stop distance between endpoints, ticketing and operating carrier,[7] market fare,[8] and number of passengers paying a particular market fare. I augment this data with monthly data on the number of delayed flights from the Airline On-Time Performance Data set, also from the Bureau of Transportation Statistics. Finally, I use yearly data from the Bureau of Economic Analysis's Local Area Personal Income tables on population and per capita personal income, as well as their Annual Personal Income by Major Source and Earnings by Industry (Table SA05) dataset to obtain information on both accommodation[9] and nonfarm earnings for metropolitan statistical areas (MSA).

The sample time period for this paper is 1998 to 2009. I start with 1998 because the Bureau of Transportation Statistics did not ask carriers to report whether the operating carrier differed from the ticketing carrier until that year, while partnerships between legacy carriers and regional airlines could have been affected by the completion of the Delta-Northwest merger in 2009. As such, 1998-2009 provides a clean time frame to analyze the growth of regional airlines.

The following steps are undertaken to clean the data. First, I eliminate all observations where the distance was equal to zero or the market fare is less than $10. Observations with an unidentified ticketing carrier are also dropped. Only observations related to coach fares on nonstop flights are

[7]The key distinction between the ticketing carrier and the operating carrier is that the ticketing carrier is the airline that the passenger purchased the ticket from, whereas the operating carrier is the airline that is in charge of the aircrew and fleet used on the flight.

[8]Market fare is calculated by the Bureau of Transportation Statistics as the itinerary yield multiplied by the number of miles flown. Ancillary fees, such as baggage fees, priority seating fees, and the cost of food and beverage purchased on the flight, are not accounted for in the market fare.

[9]According to the Bureau of Economic Analysis, the accommodation industry includes hotels, motels, and other traveler accommodations.

kept.[10] I then limit the sample to routes within the contiguous United States with a maximum distance of 1,500 miles since regional airlines would not be used on longer routes and restrict the sample to the 2,500 routes with the highest number of passengers from 1998 to 2009. I drop routes that are never serviced by a legacy carrier in order to focus on routes where there is the potential for strategic behavior between legacy carriers[11] and low-cost carriers.[12] In some cases, data on the number of delayed flights or accommodation earnings are not reported. Routes with incomplete information on either of these two variables are eliminated.

4 The Effect of Regional Airline Entry on Pricing

This section investigates how outsourcing to regional airlines alters the pricing strategy of the outsourcing legacy carrier. Legacy carriers could potentially charge lower prices by exploiting the regional airlines' more efficient cost structure. I run a two-way fixed effects regressions on logged average airfares in order to study price changes associated with regional airline entry.

Observations from the DB1B for every quarter between 1998:Q1 to 2009:Q4 is merged with the annual population estimates of metropolitan statistical areas (MSA) in the United States for every year between 1998 to 2009 from the Bureau of Economic Analysis. The population for the airport's MSA is assumed to be constant for each quarter in a particular year. An observation in the resulting dataset is at the carrier-route-year-quarter level.

I construct one dependent variable and seven control variables to be used in the price regressions. The dependent variable ($lnprice$) is the logged average airfare set by the ticketing carrier - operating carrier combination for a particular route in a given year-quarter time period. I create two market share variables called $msroute$ and $msapt$, which calculated the market share of the carrier on a particular route and the arithmetic mean of the carrier's market share at the endpoint airports on a particular route in a given year-quarter, respectively. I proxy for market concentration by constructing the route's Herfindahl-Hirschman Index in a particular year-quarter ($HHIroute$) and the arithmetic mean of the Herfindahl-Hirschman Indexes at endpoints on a route in a given

[10] It can be the case that regional airlines are flying travelers on one leg of a one-stop or multi-stop itineraries. However, the issue with these itineraries is that a legacy carrier can be responsible for a portion of the the one-stop or multi-stop itineraries as well. In other words, I focus on nonstop products in order to avoid the complication with some passengers flying on a legacy carrier plane to get them from a origin airport to a hub airport and then a regional airline from the hub airport to the final destination airport. Thus, focusing on nonstop products lends to a cleaner analysis of the legacy carrier's decision to operate that particular route themselves or to outsource to a regional airline.

[11] The legacy carriers studied in this paper are American Airlines, Continental Airlines, Delta Air Lines, Northwest Airlines, United Airlines, and US Airways.

[12] The low-cost carriers studied in this paper are AirTran Airways, JetBlue Airways, Southwest Airlines, and Spirit Airlines.

time period ($HHIapt$). Both market share variables and market concentration variables are based on the number of passengers flown by a given ticketing carrier. In order to control for market size, I use the population data to create pop, which is the geometric mean of the endpoint's MSA population in millions. Finally, legacy carrier - regional airline partnerships are defined using the Regional Airline Association's Annual Reports. I use this information to construct the variable of interest, $REGoperating$, which assumes the value of 1 the year-quarter that a legacy carrier starts to outsource to a regional airline and every subsequent year-quarter that the regional airline operates on behalf of that legacy carrier, and 0 otherwise.

I keep observations that pertain to a legacy carrier who decides to start using a regional airline partner as the operating carrier on a route that it previously operated itself during the sample time period (1998:Q1 - 2009:Q4). This subsample contains 91,777 observations on 1,313 routes from 1998:Q1 to 2009:Q4. Summary statistics are reported in Table 1.

Table 1: Summary Statistics
Data for Price Regressions

Variable	Definition	Mean (Std. Dev.)
$price_{ijt}$	Average one-way market fare for carrier i	200.50
	on route j in time period t	(89.40)
$msroute_{ijt}$	Market share for carrier i on route j in time period t	0.400
		(0.340)
$HHIroute_{jt}$	Herfindahl Index for route j in time period t	0.598
		(0.209)
$msapt_{ijt}$	Arithmetic mean of carrier i's market share	0.235
	at endpoints on route j in time period t	(0.137)
$HHIapt_{jt}$	Arithmetic mean of Herfindahl Indexes	0.333
	at endpoints on route j in time period t	(0.099)
pop_{jt}	Geometric mean of population (in millions) of origin and	3.24
	destination airports' MSA on route j in time period t	(2.02)
$REGoperating_{ijt}$	Indicator variable equal to 1 if carrier i is a legacy carrier	0.313
	and switches to a regional airline on route j in time period t	(0.464)
	or prior to time period t, and 0 otherwise	
Routes	Number of routes in the sample	1,313
N	Number of observations	91,777

I use a fixed effects approach to perform an event study that measures the change in the legacy carrier's price once it outsources to a regional airline while controlling for time-invariant and route-specific factors. As such, the dependent variable used is the legacy carrier's logged average airfare (*lnprice*). The specification is as follows:

$$lnprice_{ij,t} = \gamma_{ij} + \nu_t + \alpha X_{ij,t} + \beta REGoperating_{ij,t} + \varepsilon_{ij,t}, \tag{1}$$

where γ_{ij} is the carrier-route fixed effect, ν_t is the year-quarter fixed effect, $REGoperating_{ij,t}$ is the indicator variable used to identify when a legacy carrier i switches the operation of a route to a regional airline on route j in time period t or prior to time period t, and $X_{ij,t}$ are the other control variables discussed above.[13] Standard errors are clustered by carrier-route to account for heteroskedasticity and serial correlation between a carrier-route combination. *REGoperating*, the key variable of interest, captures the change in price charged when a regional airline operates on a route relative to what the legacy carrier charged when it previously operated the route itself. Given that regional airlines have a more efficient cost structure than legacy carriers, the sign for *REGoperating* is hypothesized to be negative and significant, implying that legacy carriers decrease their average prices once they outsource the operation of a route to a regional airline.

Table 2: Legacy Carrier Price Response to Outsourcing

Dependent variable	*lnprice*	
Variable	Coefficient	Standard error
Route-level market share (*msroute*)	0.007	(0.020)
Route concentration (*HHIroute*)	0.203**	(0.021)
Airport-level market share (*msapt*)	−0.138*	(0.067)
Airport concentration (*HHIapt*)	0.210**	(0.075)
Population (*pop*)	0.364**	(0.096)
Operates using regional airline (*REGoperating*)	−0.111**	(0.006)
N	91,777	

Note: This table reports the results of the two-way fixed effects price regressions outlined in Equations 1. Observations are at the carrier-route-year-quarter level. Route and year-quarter fixed effects suppressed. Standard errors are clustered by carrier-route to account for correlation between a carrier-route combination over time.
* indicates significance at 5% level.
** indicates significance at 1% level.

Table 2 summarizes the price regression results that estimates how legacy carriers change their average price once they switch to regional airlines. The coefficient for *REGoperating* (-0.111)

[13] Endogeneity might arise if regional airlines could sell tickets for flights that it operates on behalf of the legacy carrier. However, this is not the case in reality. Regional airlines cannot sell tickets independently from legacy carriers. Regional airlines rely exclusively on legacy carriers for passenger traffic. In fact, official websites for regional airlines will merely identify the routes that it services for legacy carriers and sometimes include links to the legacy carrier's official website for ticketing purposes. Since regional airlines do not decide which routes to fly on themselves or the air fares for those routes, then endogeneity does not become a major concern here either.

is both negative and significant at the 1% level, which implies that legacy carriers decrease their average price by 10.5%,[14] on average, when they outsource a route to a regional airline. This is consistent with the idea that outsourcing allows the legacy carrier to charge lower prices, which may allow it to better compete with rival carriers on that route or may be an entry-limiting tactic against potential entrants. Given this price effect of outsourcing, the following section analyzes the competitive motivations for a legacy carrier to switch the operating of a route to a regional airline.

5 Motivations for Regional Airline Entry

This section analyzes two possible mechanisms through which competitive pressures from low-cost carriers could influence the decision to outsource to regional airlines: 1) outsourcing as a pro-competitive response to current competition with low-cost carriers and 2) outsourcing as an anti-competitive strategy that erects a barrier to entry against low-cost carriers. I examine the first explanation by testing whether legacy carriers are more likely to switch to a regional airline on routes where low-cost carriers are present. This is done using a two-way fixed effects logit regression of entry by regional airlines on the number of low-cost carriers operating on a route, as well as other control variables. Second, I estimate the effect of regional airlines on entry by low-cost carriers in order to test whether the presence of a regional airline reduces the likelihood that low-cost carriers enter that route. In other words, I investigate whether legacy carriers outsource to regional airlines where they attempt to preclude future entry by regional airlines.

Observations from the DB1B and the Airline On-Time Performance Data are aggregated to the year level so that the final dataset contains route-year observations. Thus, the main distinction between this dataset and the one used in the previous section is that observations are at the carrier-route-year-quarter combination for the price regression in Section 4, whereas the dataset used in this section is aggregated to the route-year level. Entry is identified when an airline starts servicing a route and remains on that route for at least two consecutive quarters. In some cases, airlines are seen in the DB1B to operate on a particular route only to drop out for a quarter and reappear in the subsequent quarter. This is not an example of actual entry but represents an issue with the DB1B being a ten percent sample of airline tickets. Nevertheless, this problem was resolved by qualifying entry when the carrier did not service the route in question for at least four quarters before the identified quarter of entry. The carrier must have also flown at least 100 passengers on the entered route in the quarter of entry. The final dataset contains 12,790 observations on 1,161 routes from 1998 to 2009.

[14] Given the log-linear specification in Equation 1, this is calculated as exp(-0.111) - 1 = -0.105.

Table 3: Summary Statistics
Data for Entry Regressions

Variable	Definition	Mean (Std. Dev.)
$REGentry_{it}$	Indicator equal to 1 if a regional airline enters on route i in time period t, and 0 otherwise	0.122 (0.328)
$LCCentry_{it}$	Indicator equal to 1 if a low-cost carrier enters on route i in time period t, and 0 otherwise	0.028 (0.166)
$WNentry_{it}$	Indicator equal to 1 if Southwest Airlines enters on route i in time period t, and 0 otherwise	0.006 (0.078)
$otherLCCentry_{it}$	Indicator equal to 1 if a low-cost carrier other than Southwest Airlines enters on route i in time period t, and 0 otherwise	0.023 (0.149)
$distance_i$	Distance (in miles) between the endpoints of route i	723.65 (339.84)
$passengers_{it}$	Number of passengers on route i in time period t Note: $lndensity_{it} = \ln(passengers_{it})$	29859.29 (29346.83)
$pdelay_{it}$	Percentage of flights delayed over 15 minutes on route i in time period t	0.202 (0.084)
pop_{it}	Geometric mean of population (in millions) of origin and destination airports' MSA on route i in time period t	3.402 (2.204)
$income_{it}$	Geometric mean of per capita income (in tens of thousands) of origin and destination airports' MSA on route i in time period t	3.582 (0.547)
$tourism_{it}$	Maximum of the percentage of accommodation income in nonfarm income of origin and destination airports' MSA on route i in time period t	1.745 (20.415)
$HHIroute_{it}$	Herfindahl-Hirschman Index for route i in time period t	0.578 (0.206)
$maxshare_{it}$	Maximum of the market share of carriers on route i in time period t	0.691 (0.184)
$nLEG_{it}$	Number of legacy carriers operating route i in time period t	2.647 (1.456)
$nLCC_{it}$	Number of low-cost carriers carriers operating route i in time period t	0.572 (0.593)
$nREG_{it}$	Number of regional airlines servicing route i in time period t	1.057 (1.269)
$nOTHER_{it}$	Number of other carriers (not legacy carrier, low-cost carrier, or regional airline) servicing route i in time period t	0.596 (0.890)
Routes	Number of routes in the sample	1,161
N	Number of observations	12,790

There are three types of control variables: market variables, demographic variables, and competition variables. Market variables include the natural log of the number of passengers on a route ($lndensity$)[15] and the percentage of flights on a route that were delayed at least 15 minutes

[15]The $lndensity$ variable includes the total number of nonstop and connecting passengers on a route in order to accurately represent market demand and because it is well understood that low-cost carriers target entry on routes that have limited non-stop service.

($pdelay$). Demographic variables include the maximum of the ratio of accommodation earnings to nonfarm earnings for each endpoint on a route ($tourism$), as well as the geometric mean of the population (pop) and per capita income ($income$) of the MSA where the origin and destination airports are located. Finally, I include competition variables to control for the maximum market share of a servicing airline on that route ($maxshare$) and the route-level Herfindahl-Hirschman Index ($HHIroute$). I also control for the number of competing airlines by including the number of legacy carriers ($nLEG$), low-cost carriers ($nLCC$), regional airlines ($nREG$), and other airlines[16] ($nOTHER$) operating on that route. Summary statistics for this dataset is reported in Table 3.

5.1 The Pro-Competitive Use of Regional Airlines

I use a fixed effects approach to exploit the panel structure of my data in order to test whether the presence of low-cost carriers affect the likelihood that a legacy carrier outsources to a regional airline while controlling for time-invariant, route-specific factors. I am interested in routes where legacy carriers have a choice to operate with a regional airline or not so the data only includes routes where legacy carriers service during the sample time period. Legacy carriers tend to employ a regional airline on routes that they previously operated themselves. Entry in this sense is defined when a legacy carrier starts using a regional airline where it had previously served as both the ticketing and operating carrier. Once a regional airline has entered the route, the legacy carrier remains as the ticketing carrier, but the regional airline becomes the operating carrier. Thus, I construct $REGentry$ as a dependent variable, which assumes the value of 1 when a legacy carrier switches to a partnered regional airline, and 0 otherwise.

The specification for the two-way fixed effects logit regression model is as follows:

$$REGentry_{i,t+1} = \gamma_i + \nu_t + \alpha X_{i,t} + \beta nLCC_{i,t} + \varepsilon_{i,t}, \tag{2}$$

where $REGentry_{i,t+1}$ is the indicator variable that identifies entry by a regional airline, γ_i is the route fixed effect, ν_t is the year fixed effect, $nLCC_{i,t}$ is the number of low-cost carriers operating on route i in year t, and $X_{i,t}$ are the other control variables explained above. Note that the control variables are in terms of period t, whereas the dependent variable relates to period $t+1$. In other words, I am looking at the effect that the control variables in a particular year will have on entry by

[16]Other airlines are simply domestic airlines that do not fit into either legacy carrier, regional airline, or low-cost carrier categories. This includes (but is not limited to) Alaska Airlines, Hawaiian Airlines, and Midwest Airlines. To be sure, the market density, market concentration, and market share variables include the passenger volume of these airlines.

regional airlines in the subsequent year.[17] I am particularly interested in the sign and significance of the *nLCC* variable, which controls for the number of low-cost carriers operating on the route. If regional airlines are more likely to be used where low-cost carriers are present, then the estimated coefficient for *nLCC* should be positive and statistically significant.

Table 4: Entry by Regional Airlines

Dependent variable	*REGentry*	
Variable	Logit coefficient	Standard error
Market density (*lndensity*)	-0.311^{*}	(0.136)
Airport congestion (*pdelay*)	2.099^{**}	(0.560)
Population (*pop*)	-0.640	(0.350)
Per capita income (*income*)	-0.931^{*}	(0.425)
Tourist market (*tourism*)	-0.197	(0.140)
Route concentration (*HHI*)	-0.775	(0.853)
Maximum market share (*maxshare*)	0.331	(0.901)
Number of legacy carriers (*nLEG*)	-0.023	(0.080)
Number of low-cost carriers (*nLCC*)	0.436^{**}	(0.151)
Number of regional airlines (*nREG*)	-0.300^{**}	(0.037)
Number of other airlines (*nOTHER*)	0.100	(0.057)
N	7,785	

Note: This table presents the results for the two-way fixed effects logit regression method on entry by regional airlines. Entry is defined when a legacy carrier switches operation of a route to a regional airline. Observations are at the route-year level. Route and year fixed effects suppressed.
* indicates significance at 5% level.
** indicates significance at 1% level.

Table 4 reports the results of the two-way fixed effects logit model. The estimates suggest that legacy carriers tend to start using regional airlines on routes where low-cost carriers are present since the estimated coefficient for *nLCC*[18] (0.436) is both positive and significant at the 1% level.

[17] Endogeneity could arise if the use of regional airlines by various legacy carriers is not independent. In other words, endogeneity could be a major concern if multiple legacy carriers switch to regional airlines on the same route in the same time period. However, a deeper investigation into the dataset reveals that this is luckily not the case. Of the 12,790 observations in the dataset, 11,226 observations are associated with the case that no legacy carrier switched to a regional airline on that route in that year. In the 1,564 observations pertaining to a switch in the operation of a route from the legacy carrier to regional airline, only 67 observations (4.3%) are related to the case when more than one legacy carrier started outsourcing to a regional airline. This suggests that a legacy carrier's decision to outsource to a regional airline is not affected by rival legacy carriers' actions at that time. Unsurprisingly, removing these 67 observations from the dataset yields qualitatively similar regression results.

[18] Out of the 12,790 observations in the data sample, 6,103 observations pertained to routes with no low-cost carrier competition and 6,115 observations with only one low-cost carrier servicing the route. Thus, only 572 of 12,790 observations (4.5%) pertain to routes services by two or three low-cost carriers. There are no routes in the data set that were serviced by more than three low-cost carriers. As a robustness check, I replaced *nLCC* with one of two variables

The results also show that the presence of other regional airlines operating on behalf of rival legacy carriers discourages legacy carriers to start using a regional airline themselves as the estimated coefficient for *nREG* (-0.300) is negative and statistically significant. Finally, outsourcing would be more likely to occur on routes that experience a high frequency of delay (*pdelay*), as well as routes that are traveled by less passengers (*lndensity*) and that connect markets with lower per capita income (*income*). This is likely to be the case since regional airlines are used to integrate small cities into the legacy carrier's route network.

The results imply that legacy carriers are more likely to use regional airlines where they currently compete with low-cost carriers. However, it could also be the case that legacy carriers outsource to regional airlines on routes where they intend to deter future entry by low-cost carriers. The rest of this section investigates whether regional airlines could serve as an effective barrier to entry to low-cost carriers.

5.2 The Use of Regional Airlines as a Barrier to Entry

Previous papers have estimated barriers to entry using a logit model. Cotterill and Haller (1992) find that the number of large supermarket chains in a particular market serves as an effective barrier to entry. Cetorelli and Strahan (2006) conclude that banks with market power erect a significant financial barrier to entry. These papers generally use entry in the relevant market as a dependent variable and test whether particular market conditions affect entry rates. If a logit coefficient for a particular variable is negative and statistically significant, then that variable is determined to be an effective barrier to entry.

In order to test whether regional airlines effectively deter entry by low-cost carriers, I utilize *LCCentry*, an indicator variable equal to 1 when a low-cost carrier enters the route in the following year, and 0 otherwise, as the dependent variable in a two-way fixed effects logit regression model with the following specification:

$$LCCentry_{i,t+1} = \gamma_i + \nu_t + \alpha X_{i,t} + \beta nREG_{i,t} + \varepsilon_{i,t}, \tag{3}$$

where $LCCentry_{i,t+1}$ is the indicator variable that identifies entry by a low-cost carrier, γ_i is the route fixed effect, ν_t is the year fixed effect, $nREG_{i,t}$ is the number of regional airlines on route i in year t, and $X_{i,t}$ are the other control variables explained above. Note that the control variables are

in Equation 2. First, I included an indicator variable for whether any low-cost carrier is in the market. Second, I included an indicator variable for whether only one low-cost carrier is in the market and 0 if no low-cost carrier is in the market, which effectively drops any observations related to the presence of two or more low-cost carriers. Regardless, the results using either indicator variable are qualitatively similar.

in terms of period t, whereas the dependent variable relates to period $t+1$. In other words, I am looking at the effect that the control variables in a particular year will have on entry by low-cost carriers in the subsequent year. I am particularly interested in the estimated sign and significance of the *nREG* variable, which accounts for the number of regional airlines operating on the route. If regional airlines serve as an effective barrier to entry to low-cost carriers, the estimated coefficient for *nREG* should be negative and statistically significant.

Table 5: Entry by Low-Cost Carriers

Dependent variable	*LCCentry*	
Variable	Logit coefficient	Standard error
Market density (*lndensity*)	-0.778^{**}	(0.248)
Airport congestion (*pdelay*)	-3.425^{**}	(1.161)
Population (*pop*)	-0.176	(0.724)
Per capita income (*income*)	-0.759	(0.974)
Tourist market (*tourism*)	-0.092	(0.213)
Route concentration (*HHI*)	0.062	(2.023)
Maximum market share (*maxshare*)	-1.089	(2.189)
Number of legacy carriers (*nLEG*)	-0.123	(0.175)
Number of low-cost carriers (*nLCC*)	-4.264^{**}	(0.288)
Number of regional airlines (*nREG*)	-0.005	(0.091)
Number of other airlines (*nOTHER*)	0.260	(0.133)
N	3,597	

Note: This table presents the results for the two-way fixed effects logit regression method on entry by four low-cost carriers (AirTran Airways, JetBlue Airways, Southwest Airlines, and Spirit Airlines). Observations are at the route-year level. Route and year fixed effects suppressed.
* indicates significance at 5% level.
** indicates significance at 1% level.

Table 5 reports the regression results. The control variable of interest is *nREG*,[19] which is the number of regional airlines operating on the route. The logit coefficient for *nREG* (-0.005) is negative, yet statistically insignificant, implying that there is no evidence of regional airlines effectively limiting entry by low-cost carriers. To be clear, the empirical results are not able to discern whether a legacy carrier initially intended to erect a barrier to entry; rather, the results merely suggest that a barrier to entry is ultimately ineffective regardless of intent. Thus, the results suggest that legacy carriers are unable to effectively preclude entry by a low-cost carrier by outsourcing to regional airlines.

[19] Alternatively, I used an indicator variable that is equal to 1 if any regional airline operates on the route and 0 otherwise. The results using this regional presence variable are qualitatively similar.

The regression results suggest three variables that have a significant impact on low-cost carrier entry. Both the logged number of passengers on the route (*lndensity*) and the percentage of delayed flights (*pdelay*) have a negative and significant effect, implying that low-cost carriers generally tend to avoid congested routes that are likely to cause disruptions to their route network. Moreover, a higher number of low-cost carriers operating on a route (*nLCC*) significantly inhibits rival low-cost carriers from entering a route. That is not to say that low-cost carrier presence completely blocks entry. In fact, there are some cases where low-cost carriers enter a route despite the presence of a rival low-cost carrier. Nevertheless, the results suggest that this type of competition discourages a possible low-cost carrier entrant from actually entering the route.

5.3 Robustness Checks for Entry by Low-Cost Carriers

The results in the previous subsection suggest that legacy carriers do not effectively use regional airlines as an anti-competitive mechanism against low-cost carriers. However, the insignificant coefficient for *nREG* in Table 5 does not necessarily imply that this non-result is truly a zero-result. The rest of this section discusses the robustness checks used to confirm that regional airlines do not effectively preclude entry by low-cost carriers.

Industrial organization economists have been interested in Southwest Airlines as a case study on the effect of low-cost carriers in the airline industry. Southwest Airlines has a reputation of not being susceptible to aggressive entry deterrence strategies by incumbents.[20] Consequently, it could be the case that the results from Table 5 are largely influenced by Southwest Airlines. In order to check that other low-cost carriers are similarly unaffected by regional airlines, I run separate regressions with either entry by Southwest Airlines (*WNentry*)[21] or by other low-cost carriers (*otherLCCentry*) as the dependent variable.

The results in Table 6 suggest that some factors that affect entry by Southwest Airlines do not affect entry by other low-cost carriers, and vice-versa. Southwest Airlines is more apt to enter routes in touristy markets (*tourism*), while other low-cost carriers are less inclined to enter dense routes (*lndensity*) that are prone to delays (*pdelay*). The only determinant that significantly affects both Southwest Airlines and other low-cost carriers is the number of low-cost carriers operating on the route (*nLCC*), which suggests that the presence of low-cost carriers significantly deters entry by rival low-cost carriers, in general.

[20]Bamberger and Carlton (2006) find that Southwest Airlines has a high survival rate, meaning that Southwest Airlines successfully remains on an entered route for at least a year after entry.

[21]WN is the International Air Transport Association code for Southwest Airlines.

Table 6: Entry by Southwest Airlines vs. Other Low-Cost Carriers

Dependent variable	*WNentry*		*otherLCCentry*	
Variable	Logit coefficient	Standard error	Logit coefficient	Standard error
Market density (*lndensity*)	−0.950	(0.658)	−0.666*	(0.303)
Airport congestion (*pdelay*)	−2.954	(3.040)	−3.737**	(1.270)
Population (*pop*)	−2.555	(2.500)	−1.432	(0.841)
Per capita income (*income*)	3.176	(2.908)	−2.325*	(1.091)
Tourist market (*tourism*)	1.924*	(0.892)	−0.348	(0.270)
Route concentration (*HHI*)	−8.122	(5.449)	3.339	(2.294)
Maximum market share (*maxshare*)	4.093	(6.057)	−2.468	(2.428)
Number of legacy carriers (*nLEG*)	0.483	(0.490)	−0.276	(0.200)
Number of low-cost carriers (*nLCC*)	−5.592**	(0.953)	−3.645**	(0.298)
Number of regional airlines (*nREG*)	−0.124	(0.269)	0.050	(0.101)
Number of other airlines (*nOTHER*)	0.260	(0.377)	0.263	(0.148)
N	869		2,992	

Note: This table presents the results for the two-way fixed effects logit regression method on entry by both Southwest Airlines and other low-cost carriers (AirTran Airways, JetBlue Airways, and Spirit Airlines). Observations are at the route-year level. Route and year fixed effects suppressed.
* indicates significance at 5% level.
** indicates significance at 1% level.

The key insight from Table 6 is that regional airlines do not have an effect on either Southwest Airlines or other low-cost carriers, which provides further support for the key implications from Table 5. The logit coefficients for the number of regional airlines operating on a route (*nREG*) are statistically insignificant in both regressions. It is not surprising that Southwest Airlines is unaffected by the presence of regional airlines given its reputation of being undeterred by incumbent legacy carriers' aggressive pricing strategies. It is interesting, however, to see that other low-cost carriers are unaffected as well. These coefficients provide further evidence that regional airlines serve as ineffective barriers to entry to other low-cost carriers.

Regional airlines and low-cost carriers compete against each other on certain routes. For example, both American Airlines and Southwest Airlines fly nonstop between Los Angeles International Airport and Austin-Bergstrom International Airport, yet American Airlines uses a regional airline, Compass Airlines, to operate that route. However, these two types of airlines do not service all of the same markets. There are routes that regional airlines service that low-cost carriers would consider too thin to be profitable.[22] These routes typically link a small spoke airport with one of the legacy carrier's hub airports, such as when Delta Air Lines uses Atlantic Southeast Airlines to op-

[22]Fageda and Flores-Fillol (2012b) determine that the usage of regional airlines by legacy carriers would be more profitable on short-distance, thin routes with a higher proportion of business travel.

erate the route between Hartsfield-Jackson Atlanta International Airport and Little Rock National Airport. No low-cost carriers service this route.[23] On the other hand, low-cost carriers operate on some routes where the distance between the two endpoints is too far for the aircraft used by regional airlines. United Airlines uses its own fleet and aircrew to operate the route between Baltimore/Washington International Airport and Denver International Airport, where it also competes with Southwest Airlines. Thus, certain routes are more likely than others to be serviced by both regional airlines and low-cost carriers.

Legacy carriers could focus their use of regional airlines on routes where they anticipate entry by low-cost carriers instead of on routes where low-cost carriers are less likely to operate. If this strategy decreases the attractiveness of that route to a low-cost carrier, then both regional airlines and low-cost carriers would seemingly be attracted to some of the same routes, resulting in an upward biased coefficient for $nREG$. In order to resolve this potential endogeneity issue, I isolate a selected sample of routes that are most likely to be served by both low-cost carriers and regional airlines. By focusing on cases where regional airlines would have its highest potential effect as a barrier to entry to low-cost carriers, I am able to investigate whether regional airlines make attractive routes unattractive to low-cost carriers. In order to do this, I start by truncating the full sample to keep routes which are serviced by at least one low-cost carrier and one regional airline in every year of the sample period (1998 - 2009). I report the summary statistics (mean, 25th percentile, and 75th percentile) for the full sample and the truncated sample in Table 7.

The summary statistics in Table 7 report that low-cost carriers and regional airlines are both particularly attracted to routes that are affected by three variables: distance, secondary airports, and slot-controlled airports. First, low-cost carriers and regional airlines can both be found competing against each other on short-haul routes. The mean and interquartile range for the distance of the route, $distance$, in the truncated sample are both much lower than that in the full sample. In fact, the 75th percentile distance in the truncated sample is nearly equivalent to the 25th percentile distance in the full sample. Some metropolitan areas are serviced by multiple airports. Brueckner, Lee, and Singer (2010) identify the primary airport and secondary airport in these multi-airport markets.[24] Using their airport definitions, I construct two indicator variables that identify if either endpoint on the route is a primary airport ($primaryapt$) or a secondary airport ($secondaryapt$). If either airport is classified as either a primary airport or a secondary airport, then it is also coded to service a multi-airport city ($multiapt$). To be sure, it can be the case that neither endpoint is in a multi-

[23]Fageda and Flores-Fillol (2012a) find that regional airlines dominate thin routes in the United States, whereas low-cost carriers tend to dominate thin routes in Europe.

[24]For example, the city of Dallas contains two airports: Dallas/Fort Worth International Airport (primary airport) and Dallas Love Field (secondary airport).

airport market.[25] According to Table 7, no routes in the truncated sample appear to be identified as a secondary airport. In other words, low-cost carriers and regional airlines would never be found to simultaneously operate routes to or from a secondary airport. Finally, the summary statistics for *slots*, which is an indicator variable that assumes the value of 1 if either endpoint is a slot-controlled airport, is different between the truncated sample and the full sample. Slot-controlled airports regulate the number of takeoffs and landings that airlines are allowed each hour.[26] Table 7 shows that no route with an endpoint that uses a slot allocation would be serviced by both a low-cost carrier and a regional airline.

Table 7: Summary Statistics
(Truncated Sample)

	All Routes			Routes with Both Low-Cost Carriers and Regional Airlines		
Variable	Mean	25th Percentile	75th Percentile	Mean	25th Percentile	75th Percentile
Route distance (*distance*)	723	440	988	425	308	493
Hub airport (*hub*)	0.737	0	1	0.779	1	1
Multi-airport market (*multiapt*)	0.589	0	1	0.357	0	1
Primary airport (*primaryapt*)	0.461	0	1	0.357	0	1
Secondary airport (*secondaryapt*)	0.181	0	0	0	0	0
Slot-controlled airport (*slots*)	0.136	0	0	0	0	0
Population (*pop*)	3.402	1.867	4.255	2.380	1.130	3.595
Per capita income (*income*)	3.582	3.181	3.946	3.444	3.085	3.822
Tourist market (*tourism*)	1.745	0.546	1.211	2.483	0.502	1.036
Airport congestion (*pdelay*)	0.202	0.142	0.252	0.172	0.119	0.217

Note: This table reports the summary statistics for all routes and for routes where at least one low-cost carrier and one regional airline were present throughout the entirety of the sample period (1998-2009).

I use the interquartile range for *distance*, *secondaryapt*, and *slots* to set the parameters for the selected sample incorporating the most attractive routes for both low-cost carriers and regional airlines. I start with the full dataset, but only keep the routes that fulfill three criteria: 1) the route must have a distance between 300 and 500 miles, 2) neither endpoint of the route can be a secondary airport, and 3) neither endpoint of the route can be a slot-controlled airport. Using this new selected sample, I then run the two-way fixed effects model outlined in Equation 3 using entry

[25] In this case, *primaryapt*, *secondaryapt*, and *multiapt* for the observation would all equal 0.

[26] The four major airports using slot allocation in the United States include Chicago O'Hare International Airport, New York LaGuardia Airport, New York John F. Kennedy International Airport, and Ronald Reagan Washington National Airport.

by low-cost carriers (*LCCentry*) as the dependent variable. As with before, I am interested in the estimated sign and significance of the *nREG* variable.

Table 8 presents the regression estimates for the selected sample that includes routes in which the potential effect of regional airlines as a barrier to entry would be at its highest. The results suggest that low-cost carriers seem to shy away from dense markets (*lndensity*) with high per capita income (*income*), which reflects the trend that smaller, less affluent markets tend to offer attractive operational conditions, including lower operating costs. Most importantly, the number of regional airlines operating on a route (*nREG*) has a statistically insignificant effect on entry by low-cost carriers. Moreover, the number of low-cost carriers operating on the route (*nLCC*) is one of the variables that seems to affect low-cost carrier entry. Therefore, it is the presence of rival low-cost carriers, not regional airlines, that could deter entry by low-cost carriers.

Table 8: Entry by Low-Cost Carriers
(Selected Sample)

Dependent variable	*LCCentry*	
Variable	Logit coefficient	Standard error
Market density (*lndensity*)	−6.663*	(2.686)
Airport congestion (*pdelay*)	0.011	(7.938)
Population (*pop*)	8.551	(6.112)
Per capita income (*income*)	−22.528*	(9.391)
Tourist market (*tourism*)	0.514	(0.922)
Route concentration (*HHI*)	9.029	(10.360)
Maximum market share (*maxshare*)	−4.315	(10.402)
Number of legacy carriers (*nLEG*)	1.930*	(0.956)
Number of low-cost carriers (*nLCC*)	−4.752**	(1.457)
Number of regional airlines (*nREG*)	0.696	(0.489)
Number of other airlines (*nOTHER*)	−0.445	(0.665)
N	418	

Note: This table presents the results for the two-way fixed effects logit regression method on entry by four low-cost carriers (AirTran Airways, JetBlue Airways, Southwest Airlines, and Spirit Airlines) using the selected sample. The data truncates the full sample using three criteria: 1) the route distance is between 300 and 500 miles, 2) neither endpoint airport is slot-controlled, and 3) neither endpoint airport is a secondary airport. Observations are at the route-year level. Route and year fixed effects suppressed.
* indicates significance at 5% level.
** indicates significance at 1% level.

This specification corrects for a possible selection bias that arises when legacy carriers focus their use of regional airlines on routes where low-cost carriers are most likely to enter. Moreover, it is in this subsample of routes where regional airlines would exhibit the most potential to serve as an effective barrier to entry. Since regional airlines are found to have no effect even in these markets, then the presence of regional airlines does not significantly reduce the likelihood of entry by low-cost carriers.

Although it seems plausible that a low-cost carrier might find a route with regional airline operation to be unattractive, the regression results in Tables 5, 6, and 8 suggest that this is not the case. Legacy carriers who outsource the operation of a route to a regional airline do not inhibit low-cost carriers from entering that particular route in the future. In fact, the regression results consistently suggest that the biggest factor that could deter low-cost carrier entry is the existence of a rival low-cost carrier. The upshot is that legacy carriers do not seem to effectively use regional airlines as a barrier to entry to low-cost carriers.

The results from Table 4 imply, however, that legacy carriers use regional airlines as a response to competition against existing low-cost carriers. Legacy carriers are more likely to start using regional airlines on routes where low-cost carriers are present. Thus, legacy carriers may respond to current competition with low-cost carriers by using regional airlines, subsequently decreasing their average airfare.

6 Conclusion

This paper investigates whether the legacy carriers' decision to outsource the operation of a route to regional airlines encourages or discourages competition. I find that legacy carriers tend to decrease average prices once they switch to a regional airline. Moreover, the results suggest that legacy carriers are more likely to start outsourcing to regional airlines on routes where they currently compete with a low-cost carrier; however, I find no evidence that the presence of regional airlines on a route become an effective barrier to entry. Therefore, I conclude that legacy carriers use regional airlines as a pro-competitive response to current competition with low-cost carriers and not as an anti-competitive attempt to preclude future entry by low-cost carriers.

Although regional airlines provide a more cost-efficient alternative to operating a route themselves, legacy carriers are unable to use regional airlines on all routes. First, regional airlines use smaller aircraft that can only carry between 50-100 passengers at a time. As such, legacy carriers would not want to use regional airlines if the distance is too far or if the demand for a particular route is too high. In these cases, it would be more profitable for a legacy carrier to operate the route with their own fleet and aircrew. Moreover, "scope clauses" in labor agreements with legacy carriers limits the number of routes that can be outsourced to regional airlines. Despite these limitations, regional airlines serve as a means for legacy carriers to better compete with current competitors on certain routes.

Industrial organization economists have long been interested in pricing phenomenons, particularly in the U.S. airline industry. Previous papers have found evidence that airlines charge higher prices at their hub airport,[27] that competition affects the ability for airlines to price discriminate,[28] and that some incumbent airlines decrease their price in response to entry by a low-cost carrier, particularly Southwest Airlines.[29] This paper analyzes yet another facet of price competition between airlines by investigating how outsourcing to regional airlines enables legacy carriers to set a lower price in order to better compete with existing low-cost carriers. It would be interesting to study how the recent mergers between legacy carriers (Delta Air Lines - Northwest Airlines, United Airlines - Continental Airlines, and most recently, American Airlines - US Airways) affect their relationship with their respective regional airline partners and how price competition adapts to the imminent change in the competitive environment. However, this is left for future research.

REFERENCES

Bamberger, G., and D. Carlton (2006). "Predation and the Entry and Exit of Low-Fare Carriers." in Darin Lee (ed.), *Advances in Airline Economics I*, Elsevier.

Borenstein, S (1989). "Hubs and High Fares: Dominance and Market Power in the U.S. Airline Industry." *The RAND Journal of Economics* 20, 344-365.

Borenstein, S (1992). "The Evolution of U.S. Airline Competition." *The Journal of Economic Perspectives* 6(2), 45-73.

Borenstein, S., and N. Rose (1994). "Competition and Price Dispersion in the U.S. Airline Industry." *Journal of Political Economy* 102(4), 653-683.

Brueckner, J., D. Lee, and E. Singer (2012). "City-Pairs vs. Airport-Pairs: A Market-Definition Methodology for the Airline Industry." *Review of Industrial Organization* 44, 1-25.

Brueckner, J., and V. Pai (2009). "Technological Innovation in the Airline Industry: The Impact of Regional Jets." *International Journal of Industrial Organization* 27, 110-120.

Cetorelli, N., and P., Strahan (2006). "Finance as a Barrier to Entry: Bank Competition and Industry Structure in the Local U.S. Markets." *The Journal of Finance* 61(1), 437-461.

Cotterill, R., and L. Haller (1992). "Barrier and Queue Effects: A Study of Leading US Supermarket Chain Entry Patterns." *The Journal of Industrial Economics* 40(4), 427-440.

Dobson, P., and C. Piga (2013). "The Impact of Mergers on Fares Structure: Evidence from European Low-Cost Airlines." *Economic Inquiry* 51(2), 1196-1217.

[27] See Borenstein (1989), Lederman (2008), and Lee and Luengo-Prado (2005).

[28] See Borenstein and Rose (1994), Gerardi and Shapiro (2008), and Savin (2001).

[29] See Goolsbee and Syverson (2008), Vowles (2001), and Windle and Dresner (1999).

Evans, W., and I. Kessides (1993). "Localized Market Power in the U.S. Airline Industry." *The Review of Economics and Statistics* 75(1), 66-75.

Fageda, X., and R. Flores-Fillol (2012a). "Air Services on Thin Routes: Regional Versus Low-Cost Airlines." *Regional Science and Urban Economics* 42(4), 702-714.

Fageda, X., and R. Flores-Fillol (2012b). "On the Optimal Distribution of Traffic of Network Airlines." *European Economic Review* 56(6), 1164-1179.

Forbes, S., and M. Lederman (2007). "The Role of Regional Airlines in the U.S. Airline Industry." in Darin Lee (ed.), *Advances in Airline Economics II*, Elsevier.

Forbes, S., and M. Lederman (2009). "Adaptation and Vertical Integration in the Airline Industry." *American Economic Review* 99(5), 1831-1849.

Forbes, S., and M. Lederman (2010). "Does Vertical Integration Affect Firm Performance? Evidence from the Airline Industry." *The RAND Journal of Economics* 41(4), 765-790.

Gerardi, K., and A. Shapiro (2009). "Does Competition Reduce Price Dispersion? New Evidence from the Airline Industry." *Journal of Political Economy* 117(1), 1-37.

Goolsbee, A., and C. Syverson (2008). "How Do Incumbents Respond to the Threat of Entry? Evidence from the Major Airlines." *The Quarterly Journal of Economics* 123(4), 1611-1633.

Hirsch, B. (2007). "Wage Determination in the U.S. Airline Industry: The Role of Unions and Product Market Competition." in Darin Lee (ed.), *Advances in Airline Economics II*, Elsevier.

Karlsson, J., A. Odoni, and S. Yamanaka (2004). "The Impact of Infrastructure-Related Taxes and Fees on Domestic Airline Fares in the U.S." *Journal of Air Transport Management* 10, 285-293.

Lederman, M (2008). "Are Frequent-Flyer Programs a Cause of the Hub Premium?" *Journal of Economics & Management Strategy* 17(1), 35-66.

Lee, D., and M.J. Luengo-Prado (2005). "The Impact of Passenger Mix on Reported Hub Premiums in the U.S. Airline Industry." *Southern Economic Journal* 72(2), 372-394.

Martin, S (2002). *Advanced Industrial Economics*. 2nd. ed. Malden: Blackwell Publishers, 2002.

Reiss, P., and P. Spiller (1989). "Competition and Entry in Small Airline Markets." *Journal of Law and Economics* 32(2), 179-202.

Vowles, T (2001). "The Southwest Effect In Multi-Airport Regions." *Journal of Air Transport Management* 7, 251-258.

Windle, R., and M. Dresner (1999). "Competitive Responses to Low Cost Carrier Entry." *Transportation Research Part E* 35, 59-75.