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# How Do Incumbents Respond to the Threat of Entry on Their Networks? Evidence from the Major Airlines<sup>\*</sup>

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## Abstract

This paper examines how incumbents respond to the *threat* of entry of competitors, as distinguished from their response to competitors' actual entry. It uses a case study from the passenger airline industry—specifically, the evolution of Southwest Airlines' route network—to identify particular routes where the probability of future entry rises abruptly. When Southwest begins operating in airports on both sides of a route but not the route itself, this dramatically raises the chance they will start flying that route in the near future. We examine the pricing of the incumbents on threatened routes in the period surrounding such events. We find that incumbents cut fares significantly when threatened by Southwest's entry into their routes. This is true even after controlling in several ways for airport-specific operating costs. The response of incumbents seems to be limited only to the threatened route itself, and not to routes out of nearby competitor airports where Southwest does not operate (e.g., fares drop on routes from Chicago Midway but not Chicago O'Hare). The largest responses appear to be restricted to routes that were concentrated beforehand. Incumbents do experience short-run increases in their passenger loads concurrent with these fare cuts. This is consistent with theories implying incumbents will try to generate some longer-term loyalty among current customers before the entry of a new competitor. We examine evidence relating this demand-building motive to frequent flyer programs and find suggestive evidence in favor of this notion. There is only weak evidence that incumbents increase capacity on the routes.

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## I. Introduction

In this paper we examine how incumbents respond to the threat of entry by a competitor. Though this topic has been the object of considerable theoretical and policy debate, it has received little empirical attention, mainly due to the problems of identifying when the *threat* of entry rises (as contrasted with when entry occurs, which is directly observable).

We will examine this issue in the passenger airline industry. In this circumstance, we are able to identify discrete shifts in the threat of entry. We do this by using the expansion patterns the most famous potential competitor in the industry, Southwest Airlines, to identify circumstances where the threat of Southwest entering a specific route rises significantly.<sup>1</sup> Specifically, we look at situations where Southwest begins operating in the second endpoint airport of a route (having already been operating out of the first endpoint), but before it starts flying the route itself. We investigate how incumbents' prices respond to such threats. Since major incumbent carriers have extensive route networks (offering many possible entry episodes) and the government reports extensive fare data on these routes, we have considerable empirical variation with which to identify any effects.

As an example of our empirical strategy, consider the recent entry of Southwest airlines into the Philadelphia airport (this specific case is not in our data because it occurred so recently, but it illustrates the episodes we study). On May 9, 2004, Southwest began operations in the Philadelphia airport (PHL) with nonstop flights to six other cities in its network, and one-stop service to several others. One route Southwest did *not* offer service when they entered the Philadelphia market was Philadelphia-Jacksonville, Florida (JAX). Jacksonville is a Southwest airport. Southwest does fly between JAX and other airports, just not PHL-JAX. Once Southwest is operating out of both end points on a route—here both JAX and PHL—the probability that they will soon start flying the route between those two airports goes up dramatically. Indeed, operating in both end points raises the probability of entering the route by nearly a factor of 60 in the data presented in a later section. With that increase in probability, we can then look at, say, US Airways' and United Airlines' (the incumbents) fares on the JAX-PHL route once Southwest threatens entry but has yet to actually start flying.

The paper builds on two literatures. Empirically, it is obviously connected to the

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<sup>1</sup> Southwest's network has been expanding rapidly for some time and the impact of their actual entry on prices in a market is well known (see, for example, Morrison, 2001).

extensive literature on airline competition, especially the work relating to airport presence and the sources of airport market power.<sup>2</sup> These papers, however, have looked, almost exclusively, at the impact of actual actions rather than pre-emptive actions. Our empirical strategy is perhaps closest to Ellison and Ellison's (2000) study of incumbent drug makers' actions in the period just preceding expiration of their patents.

The paper's second connection is to the considerable body of theoretical work on strategic entry deterrence, particularly those models that offer rationale for incumbents initiating competitive actions before entry actually occurs. These include, for example, Dixit's (1979) capacity commitment motivation, the strategic learning-by-doing of Spence (1981), cost-signaling as in Milgrom and Roberts (1982), the long-term contracting environment of Aghion and Bolton (1987), and switching costs as in Klemperer (1987) and Farrell and Klemperer (2004). These rationale were forwarded as responses to the theoretical results implying that preemptive incumbent actions are irrational, either because they are not subgame perfect (in the spirit of Selten's (1978) chain-store paradox), or because costly competitive actions should be delayed until entry actually occurs. These papers counter the traditional argument that firms should act only when they actually face competition. Our empirical work tests between the two views.

The results show that incumbents do respond to the threat of entry, quite separately from their responses to actual entry. Incumbents drop average fares substantially when Southwest threatens a route but before Southwest actually enters the route. This is true even when we compare the fare changes on threatened routes to those on incumbents' other routes out of the same airports, indicating that shifts in airport-specific operating cost are not creating spurious results. As expected, the lower prices increase in the number of passengers flying the incumbents prior to entry. We also find, interestingly, that while incumbents cut fares on the threatened route, they do not cut prices on routes to nearby airports in the same market (e.g., Chicago-O'Hare when Southwest threatens a Chicago-Midway route). Further, fare cuts are considerably larger on routes that were concentrated before Southwest's threat. There is only weak evidence that airlines expand flight or seat capacity in response to the threat of entry;

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<sup>2</sup> See, for example, Reiss and Spiller (1989), Hurdle et al. (1989), Borenstein (1989, 1991, 1992), Berry (1990, 1992), Brueckner et al. (1992), Evans and Kessides (1993), Whinston and Collins (1992), Borenstein and Rose (1994), Hendricks et al. (1997), and the more recent work of Bamberger, Carlton, and Neumann (2001) or Mayer and Sinai (2004).

instead, this additional demand is taken up mostly through higher load factors. Finally, we find suggestive evidence consistent with airlines trying to increase customer loyalty through mechanisms like frequent flyer programs. The fare drops are greatest for incumbents' high-fare-paying customers and on routes with more business travelers.

## II. Data

Because we are primarily concerned with fares, we use the U.S. Department of Transportation's DB1A files from 1993 to 2002 to build the core of our sample. These data provide a 10% sample of all domestic tickets used in each quarter, which we use to compute the average, standard deviation, and specific quantiles of logged ticket prices within each route-carrier-quarter combination (unfortunately the data do not report any specific travel dates within the quarter).<sup>3</sup> Following the previous literature, we define a route by its two endpoint airports alone, not any intermediate stops along the way. We look at so-called "direct flights" (predominantly nonstop flights but technically including itineraries where the passenger stops but does not change planes). We restrict our sample to routes between airports that Southwest ever flies any flights to in our sample. This includes 838 routes between 61 different airports.

The "threatened" entry events we study are identified from the observed expansion patterns of Southwest Airlines. Southwest grew tremendously throughout our sample period. Its revenues grew from \$2.3 billion to \$5.5 billion, passenger-miles from 18.8 to 45.4 billion, and it added service to 21 new airports between the end of 1993 and the start of 2003.<sup>4</sup> Every time Southwest begins service in a new airport, it raises the threat that Southwest will enter routes connecting that airport with other airports in its network. We illustrate this in Figure 1. Southwest enters Philadelphia and begins flights from there to Tampa in the second quarter of 2004. Southwest is already flying out of Jacksonville (and has been since 1997) to cities in its network other than Philadelphia. Now, though, the entry into Philadelphia makes Southwest highly likely to start flying Philadelphia-Jacksonville in the near future.<sup>5</sup>

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<sup>3</sup> We use Severin Borenstein's cleaned files, which are aggregated up to the route-carrier-quarter level, since this is the level of our analysis rather than the ticket. We use the original source files to compute the fare quantiles since that information is not included in the Borenstein files.

<sup>4</sup> Southwest exited one airport, San Francisco International (SFO), in 2001. It had operated there since before 1993.

<sup>5</sup> Indeed, Southwest eventually did enter the PHL-JAX route in the fourth quarter of 2004. Our empirical specification captures the separate impacts of both such threatened-entry and actual-entry events.

The importance of airport presence is well known in the industry as an indicator of future entry.<sup>6</sup> In Table 1 we present a simple probit regression of whether Southwest starts flying a route in a given quarter to verify the impact of having presence in both end points on the threat of entry. This is meant only for descriptive purposes, not as an actual model of entry. It does not include extensive controls, just the number of endpoints Southwest is already operating at the beginning of the quarter and time dummies for every quarter in the sample. The results show that having a presence in one airport significantly raises the probability of entry (the baseline probability is close to zero) to a small positive number. Having a presence in both airports, though, raises it by a factor just under 60—to almost 17 percent per quarter. The existing network of the airline therefore serves as a superb predictor of entry in any empirical model.<sup>7</sup>

At any given point in time, we take that existing network as given and look at incumbents' fares on a route once it becomes clear that Southwest is looming as a competitor. To determine these price responses, we capture threatened entry effects using dummies in the quarters surrounding Southwest's establishment of operations in both endpoint airports (but without flying the route) and control for actual entry effects with dummies in quarters during and after the quarter Southwest starts flying the route. We restrict our attention to the behavior of the major carriers: American, Continental, Delta, Northwest, TWA, United, and US Airways.

We observe hundreds of routes threatened with entry over the period. In most of these cases, Southwest eventually starts flying the route at a later date in our sample; in others, Southwest establishes a presence in both airports but had not yet begun flying the route by the end of our observation period (up to three years after). We exclude any route from our sample where either Southwest never establishes an airport presence in both airports or where Southwest establishes the presence simultaneously with actually flying the route. In those latter cases we have no period with which to identify a heightened threat of entry separately from actual entry. For each route in our sample we look at a six year window surrounding the quarter in which Southwest establishes a presence in both endpoints (again, without actually flying the route). We

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<sup>6</sup> See Berry (1994) for empirical work on the subject or Bailey (1981) for a narrative discussion of a particular episode where this idea was applied in antitrust policy toward the industry.

<sup>7</sup> Below we consider a broader definition of entry that allows for the possibility that Southwest can *de facto* enter a route, even if it does not offer a direct flight, if it is carrying enough passengers between a route's endpoint cities through connecting airports. If this definition is used instead in the entry probit, the implied probabilities of entry are of course higher, but the probability ratio between entry conditional on being in both endpoints to that when Southwest is in only one endpoint is still roughly 60.

have checked and found our results robust to longer event windows.

We define Southwest's actual entry as occurring when it establishes direct service (i.e., flights without a change of plane) between the two airports. This definition of entry is easiest to understand, but we will also show that the results are not sensitive to defining Southwest's entry as including cases where they start either direct or indirect service (involving a stop and a plane change) on the route.<sup>8</sup>

In all, we observe Southwest threatening entry into 838 routes over the sample period.<sup>9</sup> We focus on the behavior of major airline incumbents in the 25 quarters surrounding the initial threat (that is, the three years before and the quarter that Southwest starts operating in the second endpoint of the route, as well as the three years after). This yields almost 19,000 route-carrier-quarter observations of average logged fares and passenger counts for major airlines' direct flights on threatened routes. Summary statistics for these variables are shown in Table 2.

### III. Hypotheses and Empirical Specifications

Our baseline model measures the impact of Southwest establishing a presence in both endpoints of a route by looking at the periods before, during, and after this event, while controlling for other influences. The basic specification, with some slight abuse of summation notation as explained below, is as follows:

$$y_{ri,t} = \gamma_{ri} + \mu_t + \sum_{\tau=-8}^{3+} \beta_{\tau} (SW\_in\_both\_airports)_{r,t_0+\tau} + \sum_{\tau=0}^{3+} \delta_{\tau} (SW\_flying\_route)_{r,t_e+\tau} + X_{ri,t} \alpha + \varepsilon_{ri,t}, \quad (1)$$

where  $y_{ri,t}$  is the outcome of interest (e.g., mean logged fares or logged total passengers) for incumbent carrier  $i$  flying route  $r$  in quarter  $t$ .  $SW\_in\_both\_airports_{r,t_0+\tau}$  are time dummies surrounding the period when Southwest establishes a presence in both endpoints of a route but before they have actually started flying the route.  $SW\_flying\_route_{r,t_e+\tau}$  are time dummies starting with the period Southwest actually starts flying on the route. Each dummy is mutually exclusive of the others, so the implied effects on the dependent variable given by their coefficients are not additive. The  $\gamma_{ri}$  and  $\mu_t$  are fixed effects for carrier-route and time. Some

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<sup>8</sup> Note that just because Southwest flies routes that could be connected does not mean that they operate a route indirectly. There are many routes where Southwest operates in both airports but they will not sell a single itinerary between the two and there are no tickets for the route in our sample.

<sup>9</sup> By the final quarter of 2002 (the end of our observation period), Southwest had actually entered about 500 of these routes.

specifications will also include a set of controls  $X_{ri,t}$ .

In all regressions, we weight observations by the number of passengers flying the route-carrier in the quarter, so larger incumbent routes have a greater impact on the measured average response than do smaller routes. We also cluster standard errors at the route level to account for any correlation in unobservables across carriers or time periods within routes.

The covariates of interest for determining threatened entry's impact on incumbent prices are the  $SW\_in\_both\_airports_{r,t_0+\tau}$  coefficients. There are dummies for different periods around the quarter Southwest establishes dual endpoint presence on the threatened route (a time period we denote  $t_0$ ). We include dummies for the periods seven or eight quarters before  $t_0$ , five or six quarters before, three or four, and one or two quarters prior. We include a separate dummy for  $t_0$  itself. We also include dummies for one or two quarters after  $t_0$  and for three or more quarters after. These post- $t_0$  dummies only take a value of one if Southwest has not yet entered the route. Essentially, because we include route-carrier fixed effects in the regressions, reported coefficients show the relative sizes of the dependent variable in the dummy period relative to its value in the period between two and three years (that is, the 9<sup>th</sup> through 12<sup>th</sup> quarters) prior to  $t_0$ .

Since Southwest typically announces service to a new airport four to six months in advance (in order to begin advertising, selling tickets and so on), we expect prices to start falling sometime before Southwest starts operating in both the endpoint airports.<sup>10</sup> What matters is not the precise moment Southwest actually begins operating in the second endpoint, but when the incumbents realize that Southwest is more likely to enter a route in the future. Announcing they are entering the second endpoint can serve the same purpose. If true, the price due to the threat of entry should occur 2 to 4 quarters before  $t_0$ .

As discussed above, the conventional, static-model view of threatened entry is that incumbents should not respond until they actually face competition. This notion, in the spirit of the classic Chicago-school critiques of predatory pricing, is based on the seemingly simple proposition that incumbents should not cut prices before they have to. To do so entails losing

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<sup>10</sup> We examined the business press prior to several of the most recent episodes of Southwest starting operations in a new airport and found that Southwest typically announced its intentions four to six months ahead of commencing operations. The true date that industry insiders find out the information may be even earlier, since Southwest would begin discussions with municipal airport authorities regarding gate leases and such (and the fact that these negotiations are taking place could well be observed by incumbents) prior to any public announcement.



profits in the short-run and has no impact on profits in the future. This view implies that the coefficients on the threat of entry should be zero.

However, three alternatives that might rationalize preemptive incumbent reactions. They all have to do with dynamic effects. They are: reducing costs in the presence of learning-by-doing, signaling, and generating some kind of long-term customer loyalty.

The first of these implies that when the industry technology involves learning by doing, an incumbent firm facing the threat of entry may want to overproduce (in the sense that it will set prices lower and sell more output than would be implied by the static game alone) so that in the future, when the potential competitor would seek to enter, it will be a lower-cost and tougher competitor. While such strategic considerations may be important in other industries, we do not find learning-by-doing plausible here. The incumbents in our industry have all been operating for decades and scale economies seem dubious.

Second, incumbent airlines could deter Southwest's entry by signaling that they have low costs on the route or are particularly committed to dominating the route, as in the spirit of, say, Milgrom and Roberts (1982). Our view is that this, too, does not fit this industry well. Through publicly available data sets (like the ones we use in this paper) airlines can observe a large share of their competitors' total costs and demand conditions such as capital stock attributes (planes' ages, fuel consumptions, and carrying capacities), labor costs, load factors, etc. They also have public knowledge of labor negotiations as well as gate lease agreements signed with public airport authorities. Moreover, Southwest has entered these same incumbents' routes dozens of times, so one would expect they would already have a solid idea of the credibility and type of their rivals. Though one can always devise a signaling model to explain the behavior we observe, *a priori*, it seems a bit of a stretch in this case.<sup>11</sup>

A third and we think more plausible alternative is that incumbents' fare cuts before Southwest enters create some longer term loyalty among their customers. Such a mechanism would introduce a dynamic element to demand. By locking in a customer base before actual entry occurs, the major carriers could dampen the competitive impact of Southwest's actual entry if and when it does occur, similar to the idea of using long-term contracts as a barrier to entry as

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<sup>11</sup> More subtle theories of signaling might involve things like incumbents signaling their willingness to protect a threatened route because it provides important connecting services to passengers or because the route is a "signature" route of the carrier. However, we do not see any way to test for these possibilities against the more straightforward story given the available data.

in Aghion and Bolton (1987), or when there are switching costs inherent in changing to another provider, as discussed in Klemperer (1987). The airline industry even has an straightforward mechanism in place—frequent flyer programs—that induces just this sort of dynamic demand behavior, and such issues have been discussed in work such as Cairns and Galbraith (1990), Borenstein (1996), and Lederman (2004). Anything that might generate long term loyalty through early price cutting would suffice, however.

#### **IV. Baseline Empirical Results**

Table 3 presents the results from estimating specification (1) using the average logged fares on incumbent carriers' routes faced with the threat of entry by Southwest. Column 1 presents the baseline specification where Southwest's actual entry is defined as occurring when it starts direct flights between the two cities. To document that the prices are not arising from indirect competition from Southwest connecting flights, column 2 classifies Southwest entry into a route as either when it starts direct flight service or when at least 40 passengers fly between the route's endpoints via change-of-plane service. For a one-in-ten sample, this restricts the sample to routes that a passenger flies on Southwest at least around once per month.<sup>12</sup> The number of observations falls with change-of-plane entry definition because we look only at routes where Southwest establishes a presence on both sides at least one quarter before they actually start flying the route and with the broader definition of entry, there are more routes where Southwest enters immediately.

There is a clear and statistically significant drop in prices at just the time the incumbent learns that the threat of Southwest entry has increased. In the period well before, prices show no significant trend. The coefficients on the periods 5 to 6 quarters before and 7 to 8 quarters before Southwest establishes dual presence show no significant difference from the baseline period preceding them (recall that the coefficients show the value of average logged fares relative to the excluded period, i.e., the 9<sup>th</sup> through 12<sup>th</sup> quarters before Southwest establishes a dual endpoint presence). Then, as Southwest's entry into the second endpoint airport gets closer, prices begin

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<sup>12</sup> We check results using this broader entry definition because passengers could theoretically use connecting flights from the newly-entered endpoint airport to fly Southwest between city pairs even if direct flights are unavailable. We impose the 40-passenger-per-quarter threshold for the indirect-flights to count as entry in order to avoid counting weather diversions and things of that nature as entry as well as to exclude routes where connections are available but so inconvenient as to be rarely used. The estimates were basically identical having a threshold of zero or having a larger threshold.

to fall rapidly. By 3 to 4 quarters before operating both endpoints of a route, incumbents' fares have fallen almost 11 percent (and significantly). 1 to 2 quarters prior, they have fallen 15 percent. By the time Southwest actually starts operating on both sides of the route, prices are almost 19 percent lower. The longer the delay before Southwest actually starts operations on the route, the more prices continue to fall.<sup>13</sup> As discussed above, the fact that prices begin to fall before  $t_0$  is not surprising given the fact that Southwest announces airport operations and starts selling tickets at least two quarters before airport entry and the industry insiders are likely to find out the news some time before that.<sup>14</sup>

Once Southwest actually enters in  $t_e$ , prices again fall, as seen in the *SW\_flying\_route* coefficients. Prices upon entry are immediately some 26 percent lower than in the baseline period and 32 percent lower after the third quarter following entry. Note, though, that these are not 26 and 32 percent drops *at* the time of actual entry, since prices are already down 18 percent or more from the threat of entry.<sup>15</sup> Notice too that while these post-entry coefficients are presented after all of the threatened entry coefficients, the time difference between  $t_0$  and  $t_e$  varies across routes: Southwest actually enters some threatened routes one quarter after  $t_0$ , others several quarters after, and still others it does not enter at all (at least by the end of our sample).

The results for the alternate definition of Southwest entry (when either Southwest starts flying directly or enough passengers are using connecting flights to travel between the two endpoint cities) are very similar and in fact statistically indistinguishable. Again incumbents' prices begin to fall significantly before Southwest actually starts flying a route. The timing echoes that in the direct-flight entry case and the magnitudes are very similar.

To ensure that our results are not being driven by our choice of the size of the event window or the comparison period and that the timing is correct, in Table 3A we estimate a

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<sup>13</sup> This could result from an increasing entry hazard: the longer Southwest waits, the more likely it is to enter the route in the next period. Alternatively, it may be driven by selection issues. If Southwest waits longer to enter routes where incumbents cut fares the most, this could skew the coefficients negative.

<sup>14</sup> We exclude the routes that Southwest enters right away since it is not clear how to interpret the results in those cases. When we estimated our standard specification on these routes, the results showed that these fares also dropped as soon as Southwest announces it will enter the airport, though the early drops were considerably larger for the median fares on a route than for the mean fares.

<sup>15</sup> This estimated impact of Southwest entry is smaller than that estimated in some previous work such as Morrison (2001). In that case, though, he estimates fare impacts using fare variation across routes rather than within a route across time as we do here. Our sample is also a selected one since we are restricting things to the potential entry sample.

specification that expands the event window out to four years before  $t_0$  and breaks the timing dummies out quarter-by-quarter (the excluded period is therefore the 15<sup>th</sup> and 16<sup>th</sup> quarters before  $t_0$ ). The results confirm the baseline findings. From 16 quarters before all the way to 5 quarters before, there is little pattern in prices and certainly none of the coefficients is significant. At exactly the period we believe the incumbents learn that Southwest is going to establish a presence on both sides of a route, prices begin to fall significantly. They drop by more than 12 percent over the three quarters.<sup>16</sup>

These basic results, then, suggest that incumbents are quite responsive to the threat of Southwest entry. At least half—and perhaps as much as three-quarters—of the total impact of Southwest airlines on incumbents’ fares occurs before Southwest actually enters a route. This pre-entry impact is driven by Southwest threatening entry by announcing and establishing a presence in the second endpoint airport on a route.

## **V. Testing for Plausibility and Controlling for Alternatives**

### *A. The Number Passengers*

The results seem to suggest that incumbents cut their prices by 15-20 percent before Southwest even starts flying on the threatened routes. If the price drop is real, certainly the number of passengers flying on the incumbent carriers should rise. In columns 3 and 4 of Table 3, we estimate specification (1) using the log number of passengers as the dependent variable. We once again obtain estimates for both entry definitions. The results show that at exactly the period where the incumbents prices begin to fall (3 to 4 quarters before Southwest starts operating in the two airports), the number of passengers begins to rise substantially. Depending on which time period we look at (up to the establishment of dual endpoint presence), the relative fare and passenger quantity changes imply point estimates for the price elasticity of demand between -0.82 and -1.87. We cannot rule out a somewhat broader range given the standard errors on the estimates but such magnitudes are certainly consistent with the 21 different studies of the price elasticity for air travel surveyed in Gillen et al. (2003). They find the median estimate of the price elasticity is -1.1 with the 25<sup>th</sup> to 75<sup>th</sup> percentile ranging from -0.64 to -1.4.

In addition, the fact the significant rise in quantity that accompanies the price declines

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<sup>16</sup> To verify that the estimated fare drops were truly discontinuous at that point, we also estimated a specification that added a linear time trend from the start of the event window to Southwest’s actual entry. The pattern was quite similar and still significant, though, naturally, the magnitudes were somewhat smaller.

further suggests that competition from the indirect entry of Southwest onto the route is unlikely to be the source of the price declines. With pre-emption they are trying to increase passengers today to improve demand post-entry. With competition, the demand for the incumbent should be falling.

### *B. Comparisons and Cost Controls*

In Table 4, we also consider the potential role of cost shocks as an alternative explanation for the results. In particular, if Southwest chooses to enter airports that it knows will experience positive operating cost shocks in the near future, this will lead to a spurious correlation between our measure of Southwest's threat of entry and the subsequent decline in incumbents' fares.

To control for such cost shocks we first, in columns 2 and 3, compare the fares on a threatened route to a control group of the carrier's fares on other routes involving the same airports on one end but non-Southwest airports on the other (column 1 reports again the baseline price regression from Table 3). We illustrate the principle behind the routes in the control groups in Figure 2. In the Philadelphia-Jacksonville example, the dependent variable in column 2 is the average logged fare on (say) US Airways' PHL-JAX route minus the average logged fares on US Airways' routes between PHL and airports to which Southwest doesn't fly (we restrict alternative airports to those in the top 100 to be comparable). We do the same in column 3, but now for routes between JAX and non-Southwest airports. The regressions look at what happens to incumbents' prices on a threatened route relative to their prices on their other routes out of the same airports. Any airport-specific operating cost shocks should expectedly be removed from this relative fare difference. The coefficients here are even larger than before. By the time Southwest establishes dual presence on the route, the incumbent's prices fall 20 to 24 percent relative to their prices on other routes out of those same airports.

In column 4, we go a step further and include those alternative-route prices directly in the regression as explanatory variables. (The average fares on the control routes are referred to as the "operating cost controls" in the table.) These controls have significant and positive coefficients, as one would expect. When US Airways' fares rise on routes between Jacksonville and other airports, US Airways' fares also rise on the threatened route out of Jacksonville. The estimated impact of Southwest's threat, however, is virtually unchanged with the addition of these cost controls. Whereas we previously found incumbent fares down about 19 percent by the

time Southwest establishes airport presence on both sides of a route, here we find them down about 18 percent (and not significantly different from before).

These tests indicate that fare drops on threatened routes are not merely reflecting fare declines in all routes out of the endpoint airports. Instead, the fare reductions documented in the baseline results seem independent of overall fare movements.

### *C. Concentrated Routes*

Of course, incumbent routes vary in their market structure even before Southwest threatens to enter. Some are highly concentrated, while on others incumbents face a great deal of competition. Previous work on the airline industry has suggested that the concentrated routes are places the incumbents may have market power whereas the routes with many competitors may be effectively competitive already. If true, we would expect to find a larger impact of the entry threat from Southwest on routes with higher concentration.

To get at this issue, we split our sample by the HHI of carriers on that particular route over the four quarters prior to Southwest's entry threat. Column 1 of Table 5 shows the estimates from our baseline price regression obtained using routes whose HHI is at the median or below. Column 2 shows results from routes above the median. The results show that prices only decline on the concentrated routes. On low HHI routes, incumbents' prices have fallen only about 2 percent by the time Southwest begins operating in the second endpoint airport, and this estimate is not significantly different from zero. On the high HHI routes, on the other hand, fares have dropped more than 20 percent and the coefficients are very significant.

### *D. Behavior in "Nearby" Airports*

In some large metropolitan areas, Southwest establishes its airport presence in one of the area's secondary airports. Our results above look at incumbent responses out of the Southwest airport itself, but we also want to examine cases where the incumbent operates out of a "nearby" airport that might compete with the Southwest airport. To do so we will look specifically at incumbent prices on routes flying out of LaGuardia, JFK, and Newark airports (when Southwest threatens entry into routes from Islip, Long Island), Miami (Southwest: Ft. Lauderdale), Reagan-National and Washington-Dulles (Southwest: BWI), Boston (Southwest: Providence and Manchester) and Chicago O'Hare (Southwest: Midway). We must exclude the Los Angeles, San

Francisco, Houston and Dallas markets from this regression because, during our sample period, Southwest operates in virtually all the airports in these metro areas or else regulation prevents competition.<sup>17</sup>

We date the entry threat from Southwest's actions in the other airport. So, for example, when Southwest starts operations in Orlando in 1994, they were operating on both endpoints of the Orlando-Chicago Midway route without flying the route itself. Our previous results characterize incumbent prices on that route. Here, we instead look at prices on the Orlando-Chicago O'Hare route, even though Southwest doesn't fly to O'Hare. The results on prices and passenger volumes in the nearby airport are reported in the last two columns of Table 5.

Column 3 shows no evidence that incumbent prices in the nearby airports fall when Southwest threatens entry into a route. Indeed, if anything, fares appear to be rising slightly. By the time Southwest establishes dual presence, incumbents' prices are about 7.5 percent higher than in the baseline period. Though not significant in that case, similar-sized price increases are significant in some of the earlier periods. At the very least, there is certainly no evidence that incumbents' prices fall in the neighboring airport.

This result may at first glance be surprising. However, one important thing to note is that the customer base in the nearby airport is likely changing significantly when Southwest threatens entry. The previous results documented that incumbents' fares fall substantially in the airport threatened by Southwest and that there is a big increase in passenger loads in those airports. At least some of the added passengers are likely to have been diverted from the nearby airport, and these "movers" are likely to be among the more price sensitive customers. Thus if the remaining customers have relatively inelastic demands, fares in the nearby airports need not fall, and indeed could be expected to rise.

Column 4 looks at the incumbents' passenger volumes in the nearby airports. The number of passengers falls in the period when Southwest threatens to enter (as we might expect when prices are rising slightly while fares at a competing airport in the same market are falling rapidly). This decline then becomes particularly large when Southwest actually starts operating

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<sup>17</sup> Southwest operates in the four largest Los Angeles airports: Burbank, Orange County, Ontario, LAX. Long Beach was the only neighboring airport they did not fly into and has only a tiny amount of incumbent major airline traffic in our sample. In the San Francisco Bay area, Southwest operated in the Oakland, San Jose and San Francisco airports in most of our sample (until finally exiting from SFO in 2001). The operate in Houston Hobby and Houston Intercontinental. In Dallas, a law prevents flights from Love field to anywhere but a neighboring state so the competition with DFW is quite limited.

flights on the competing route. It is important to note, however, that in most cases the major incumbents at the Southwest airport and at the nearby airport are not the same. In Chicago, for example, Continental is an incumbent that mainly flies out of Chicago-Midway while United flies exclusively out of O'Hare. The estimated effects do not imply that the same carrier is diverting passengers from its flights at one airport to its flights at another.

## **VI. How and Why Do Incumbents Respond Early?**

The results above document significant fare changes by incumbents in response to a threat of entry even before there is any outright competition from Southwest. Less clear is what the incumbents are trying to accomplish by doing so.

### *A. Capacity and Load Factor*

The first thing we consider is whether the airlines are primarily cutting prices while holding their fleet size fixed (pursuing the intensive margin) or whether prices are falling as the by-product of capacity expansion, perhaps as some form of strategic investment to deter entry. Unfortunately, the DB1A files used to construct our core sample are a sample of tickets, not flights, so they cannot speak to capacity issues like the number of flights on a route. We can get that type of information, however, from the T-100 data of the U.S. Department of Transportation. These data, rather than being a ticket-based sample, contain aggregate information at the segment-carrier-month level which we aggregate up to the route-carrier-quarter level to match our DB1A-based data. The data include the total number of passengers, the number of flights, and the total available seats on each segment. This data source also provides an independent check on the passenger number results obtained above using the DB1A data.

There are two problems with using the T-100 for our purposes. The first and more minor one results from the T-100 being based on segments rather than flights as in the DB1A. It does not count as a segment a direct flight that makes a stop without changing planes, though that would count as direct in the DB1A.<sup>18</sup> Second, and more importantly, the T-100 has serious coverage problems when the number of passengers on a segment is small. When we compare

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<sup>18</sup> A flight from Chicago O'Hare (ORD) to Washington Dulles (IAD), for example, that stops but does not involve a change of plane would show up as a direct flight in the DB1A but not as an ORD-IAD segment in the T-100.



the T-100 to our sample of 18,969 direct flight route-carrier-quarters in the DB1A, there are only 3,464 matches in the T-100. The main source of the problem is that whereas the DB1A has each route in the sample for an average of 18 quarters, the T-100 has roughly half that. In the T-100, flights appear to start, stop, and start again. Correspondingly, the match quality is much worse for the smallest segments. This matching problem is clearly concentrated in the smaller routes, however. The T-100 accounts for only about 20 percent of the route-carrier-quarters in the DB1A sample, but those 20 percent account for 95 percent of the total passengers in the DB1A. Since we are weighting each route in our regressions by the number of passengers, we are less concerned about the missing routes.

To see this in the case of passenger loads, in column 1 of Table 6 we restrict the larger DB1A sample to only those route-carrier-quarters that are also in the T-100. The results for passengers are similar to the full-sample DB1A results. Next, in column 2, we report the corresponding estimates using the T-100's independent measure of total passengers flown by the incumbents. These show results comparable to those from the DB1A. There is a significant increase in the number of passengers surrounding the threat of Southwest entry, with the magnitude and the timing showing marked similarities across the two data sets. Indeed the total effect on passengers is slightly larger in the T-100 than in the core sample.

We look at two measures of incumbent capacity on threatened routes in columns 3 and 4. Column 3 shows results for the logged number of seats available and column 4 for the logged number of flights. In both cases, there are positive but insignificant coefficients; while we cannot rule out a rise in capacity, the evidence for it is not strong. In column 5, we look at the log of the load factor (the share of available seats on the flights that had passengers in them). Here, we find statistically significant evidence that, regardless of whether the number of flights grows, significantly more people are flying *per plane*. The point estimates imply that at least 50 to 60 percent of the increase in traffic comes from higher number of passengers per plane rather than just expanding the number of planes.

### *B. Frequent Flyers*

As discussed above, frequent flyer programs are a mechanism that would provide a motive for the observed incumbent fare cuts upon Southwest's entry threat (but before its actual entry into the route). If incumbents can induce people to fly more in the period just before

Southwest's entry, and passengers with a greater stock of miles on a particular carrier are less likely to try a new airline, this could serve as a type of long-term-contract-type barrier to entry. This also implies that incumbents get the "biggest bang for their buck" by directing the greatest price drops to their passengers enrolled in frequent flyer programs.

Unfortunately we do not directly observe the preponderance of frequent flyer program members in specific cities or on specific routes, so our evidence will be indirect and probably best characterized as suggestive. We know that business travelers are the biggest users of loyalty programs (and the customers most sought after by the incumbents with those programs).<sup>19</sup> Business travelers tend to be the higher fare customers, so if their loyalty is the driving factor for the incumbents' pre-emptive responses, the price cuts should be concentrated among very different groups and locations than if they are simply trying to meet competition for low-end leisure travelers.

Although the DB1A data has no direct information about business travelers, we can look at fare quantiles to see what is happening at various points in the fare distribution. Since business travelers disproportionately account for high-fare tickets, we should therefore expect to see fares on threatened routes fall more at the high end of the distribution.<sup>20</sup> We present results of estimating (1) using the 25th, 50th and 75th percentile logged fares in columns 1 through 3, respectively, of Table 7 (here we return to the DB1A sample). The fares at each of these three quantiles fall significantly from the threat of entry, but the point estimates indicate that the 50<sup>th</sup>- and 75<sup>th</sup>-percentile fares fall by about 50 percent more than the 25<sup>th</sup>-percentile fares. The standard errors are too large to reject equality, though, so this result is somewhat tentative.<sup>21</sup>

As a second, more direct test, we compare fares on threatened routes that are more heavily populated with leisure travelers to those without. We classify routes by leisure status similarly to Borenstein (1989): for each endpoint airport's corresponding state, we compute the fraction of 1998 gross state product accounted for by the hotel industry. If this fraction is above

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<sup>19</sup> See, for example, Alden (2004).

<sup>20</sup> A separate mechanism that would also present a demand-building motive for incumbents with regard to their business travelers is that substantial business travel takes place using tickets purchased as a result of direct negotiation between large employers and incumbent carriers. A threatened incumbent may be willing to negotiate more generous deals (which would show up in our data as a drop in average fares) in order to hold such corporate business.

<sup>21</sup> Another caveat is that we cannot rule out the possibility that these results arise because markups are greater at the higher end of the distribution, and that, as with the results by route concentration above, threatened entry has a greater impact on high-markup fares.

1 percent for either endpoint of a route, we classify it a leisure-intensive route. The others we classify as business-intensive. Columns 4 and 5 present the results on fare changes for routes that are leisure- and business-intensive are shown in columns 4 and 5 of the table. Fares fall more on business routes when Southwest threatens entry. While the declines are significant in both columns, they are roughly twice as large on the business routes.

The results presented in this section are consistent with the notion that the fare drops on threatened routes reflect efforts by the incumbent to build up switching costs among its frequent-flying business customers prior to Southwest's entry, either to deter entry altogether or to put the incumbent in a better ex-post competitive position should entry occur.

## **VII. Discussion and Conclusion**

This paper has looked at the response of incumbent major airlines to the threat of entry by examining how the incumbents respond when Southwest starts operating in the airports on both ends of a route but before it actually starts flying that route. The nature of Southwest's network means that the likelihood of their entering such a route rises dramatically when Southwest starts operating in the second endpoint airport, thus generating a discrete change in incumbents' expectations about the likelihood of new competition through entry.

The results indicate that incumbents do indeed react to the threat of Southwest's entry before actual entry takes place. Incumbents drop fares significantly in anticipation of entry. This is not simply due to airport-specific cost shocks because fares drop on threatened routes relative to incumbents' fares on other routes from the same airports. The fare declines are accompanied by a sizable increase in the number of passengers flying the incumbents' threatened routes. The fare decreases are largest for routes that are concentrated beforehand, but do not decrease at all for routes into neighboring airports in the same MSA (i.e., where Southwest is not directly threatening entry). There is only weak evidence that the incumbents expand capacity (the number of available seats and flights), but there is strong evidence that load factors increase on those flights they have.

In the end, the results are consistent with a view that the incumbents are attempting to establish some kind of long-term loyalty on the part of their customers before those customers have a new carrier to choose from. One natural source of such loyalty are frequent flyer programs, though there are potentially other more amorphous mechanisms like brand loyalty.

Consistent with the frequent flyer story, quantile regressions suggest that the incumbent responses to the threat of entry are greatest among the higher fares (where frequent flyers are more prevalent) and on more business-traveler-intensive routes.

The findings of this paper suggest that Southwest Airlines has a powerful competitive effect in the U.S. passenger airline industry, and that this effect does not operate solely through Southwest's head-to-head competition with major carriers. Substantial fare reductions from major carriers are induced merely by the *threat* of competing with Southwest. We have focused on the U.S. passenger airline industry in particular because it offers a good setting to empirically identify the causes and effects of interest, and to therefore add to the still sparse empirical literature on the threat of entry. If the response of incumbents here is anything like the responses in other industries, the study of preemption and customer loyalty may be fruitful avenues for future empirical research.

## References

- Aghion, Philippe and Patrick Bolton. "Contracts as a Barrier to Entry." *American Economic Review*, 77(3), 1987, 388-401.
- Alden, Sharyn. "FAQs About Frequent Flyer Miles." *Money Savvy*, Credit Union National Association, Inc., 2004.
- Bailey, Elizabeth E. "Contestability and the Design of Regulatory and Antitrust Policy." *American Economic Review*, 71(2), 1981, 178-183.
- Bamberger, Gustavo E., Dennis W. Carlton, and Lynette R. Neumann. "An Empirical Investigation of the Competitive Effects of Domestic Airline Alliances." NBER Working Paper No. 8197, 2001.
- Berry, Steven T. "Estimation of a Model of Entry in the Airline Industry." *Econometrica*, 60(4), 1992, 889-917.
- Borenstein, Severin. "Hubs and High Fares: Dominance and Market Power in the U.S. Airline Industry." *RAND Journal of Economics*, 20(3), 1989, 344-365.
- Borenstein, Severin. "The Dominant-Firm Advantage in Multiproduct Industries: Evidence from the U. S. Airlines." *Quarterly Journal of Economics*, 106(4), 1991, 1237-1266.
- Borenstein, Severin. "The Evolution of U.S. Airline Competition." *Journal of Economic Perspectives*, 6(2), 1992, 45-73.
- Borenstein, Severin. "Repeat-Buyer Programs in Network Industries." in Werner Sichel ed., *Networks, Infrastructure, and The New Task for Regulation*, University of Michigan Press, 1996.
- Borenstein, Severin and Nancy L. Rose. "Competition and Price Dispersion in the U.S. Airline Industry." *The Journal of Political Economy*, 102(4), 1994, 653-683.
- Brueckner, Jan, Nichola Dyer and Pablo T. Spiller. "Fare Determination in Airline Hub and Spoke Networks," *RAND Journal of Economics*, 23, 1992, 309-333.
- Cairns, Robert D. and John W. Galbraith. "Artificial Compatibility, Barriers to Entry and Frequent Flyer Programs," *Canadian Journal of Economics*, 23(4), 1990, 807-816.
- Dixit, Avinash. "A Model of Duopoly Suggesting a Theory of Entry Barriers." *Bell Journal of Economics*, 10(1), 1979, 20-32.
- Ellison, Glenn and Sara Fisher Ellison (2000), "Strategic Entry Deterrence and the Behavior of Pharmaceutical Incumbents Prior to Patent Exploration," MIT Working Paper

- Evans, William N. and Ioannis Kessides. "Localized Market Power in the U.S. Airline Industry." *Review of Economics and Statistics*, 75(1), 1993, 66-75.
- Farrell, Joseph and Paul Klemperer. "Coordination and Lock-In: Competition with Switching Costs and Network Effects." forthcoming in Michael Armstrong and Robert Porter, eds., *Handbook of Industrial Organization*, Vol. 3, Amsterdam: North-Holland, 2004.
- Gillen, David, William Morrison, and Christopher Stewart, "Air Travel Demand Elasticities: Concepts, Issues, and Measurement," Department of Finance, Canada, January 23, 2003, available at <[http://www.fin.gc.ca/consultresp/Airtravel/airtravStdy\\_e.html](http://www.fin.gc.ca/consultresp/Airtravel/airtravStdy_e.html)>
- Hendricks, Ken, Michelle Piccione, and Guofu Tan. "Entry and Exit in Hub-Spoke Networks." *Rand Journal of Economics*, 28(2), 1997, 291-303.
- Hurdle, Gloria J., Richard L. Johnson, Andrew S. Joskow, Gregory J. Werden, Michael A. Williams. "Concentration, Potential Entry, and Performance in the Airline Industry." *Journal of Industrial Economics*, 38(2), 1989, 119-139.
- Klemperer, Paul. "Entry Deterrence in Markets with Consumer Switching Costs." *The Economic Journal*, 97(Supplement: Conference Papers), 1987, 99-117.
- Lederman, Mara. "Do Enhancements to Loyalty Programs Affect Demand? The Impact of International Frequent Flyer Partnerships on Domestic Airline Demand." Working Paper, Rotman School of Management, University of Toronto, 2004.
- Mayer, Chris and Todd Sinai. "Network Effects, Congestion Externalities, and Air Traffic Delays: Or Why All Delays Are Not Evil." *American Economic Review*, 93(4), 2003, 1194-1215.
- Milgrom, Paul and John Roberts. "Limit Pricing and Entry Under Incomplete Information: An Equilibrium Analysis." *Econometrica*, 50(2), 1982, 443-460.
- Morrison, Steven A. "Actual, Adjacent, and Potential Competition: Estimating the Full Effect of Southwest Airlines." *Journal of Transport Economics and Policy*, 32(2), 2001, 239-256.
- Morrison, Steven A., and Clifford Winston. "Enhancing the Performance of the Deregulated Air Transportation System." *Brookings Papers on Economic Activity, Microeconomics*, 1, 1989, 61-112.
- Reiss, Peter C. and Pablo T. Spiller. "Competition and Entry in Small Airline Markets." *Journal of Law and Economics*, 32, 1989, S179-S202.
- Selten, Reinhard. "The Chain Store Paradox." *Theory and Decision*, 9(2), 1978, pp. 127-159.
- Spence, Michael. "The Learning Curve and Competition." *Bell Journal of Economics*, 12(1), 1981, 49-70.

Whinston, Michael D. and Scott C. Collins. "Entry and Competitive Structure in Deregulated Airline Markets: An Event Study Analysis of People Express." *RAND Journal of Economics*, 23(4), 1992, 445-462.

Figure 1. Identifying a Threatened Incumbent Route

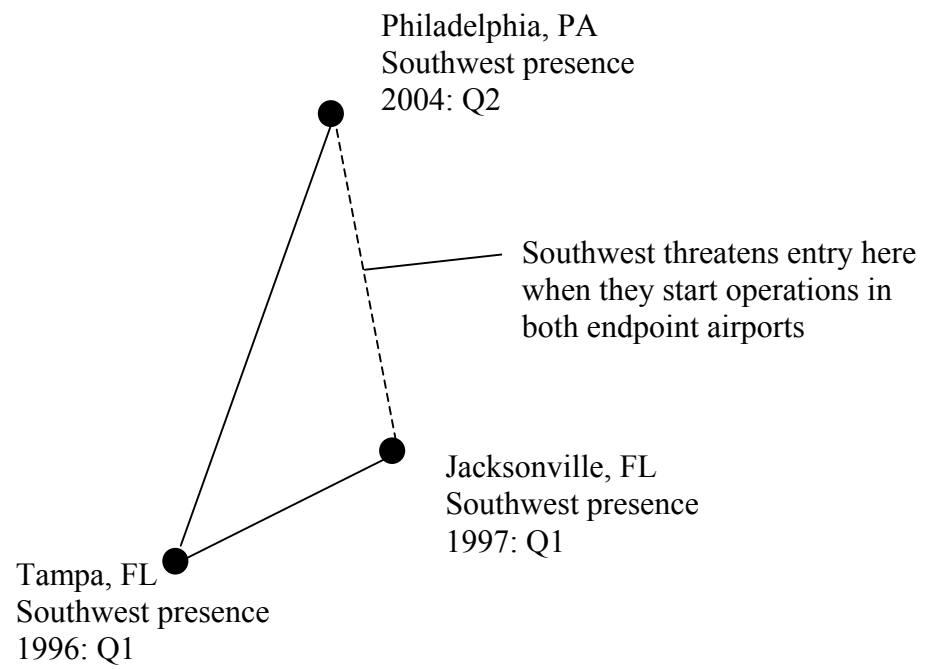




Figure 2. Comparison Routes for PHL-JAX

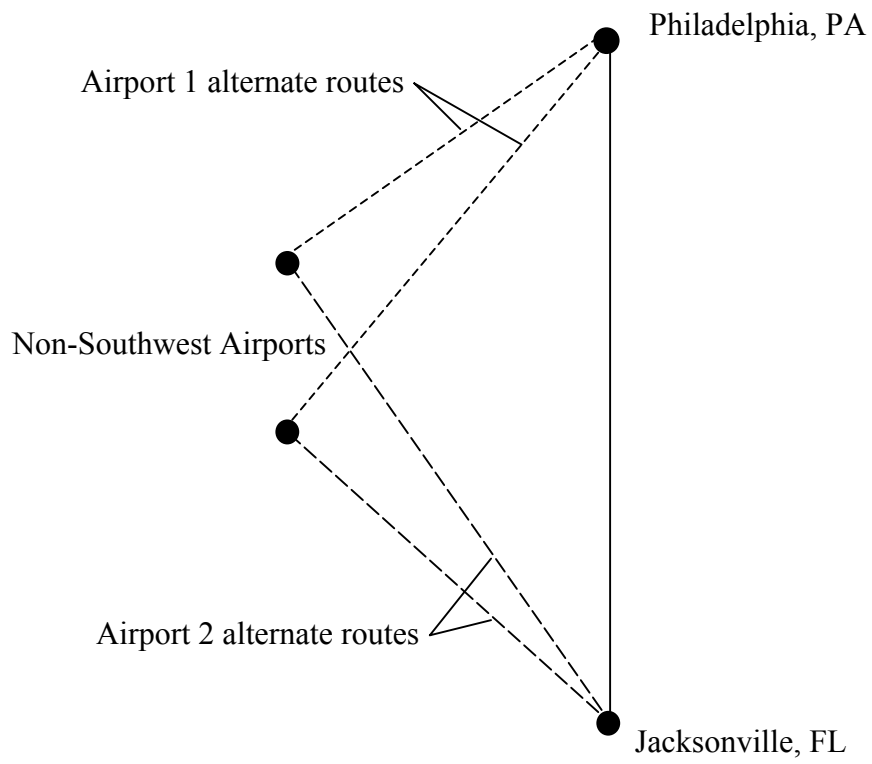


Table 1. Probability of Southwest's Entry into a Route

Southwest operates in one endpoint airport in the previous quarter (single presence)	0.003 (0.000)
Southwest operates in both endpoint airports in the previous quarter (dual presence)	0.169 (0.020)
N	143,380

Notes: The table shows estimates from a probit estimation for Southwest's entry into a route in a particular quarter, conditional on the number of the route's endpoint airports served by Southwest in the previous quarter. The excluded category includes observations where Southwest does not serve either endpoint airport in the previous quarter. Quarter fixed effects are included. Standard errors are in parentheses.

Table 2. Descriptive Statistics, Fare and Passenger Summaries

	Mean (std deviation)
<u>Direct Flights to Threatened Airport</u>	
Avg. ln(fare)	5.21 (0.45)
ln(passengers)	2.55 (2.13)
Number of Threatened Routes	678
Route-Carrier-Quarters in sample	18,969
<u>Direct Flights to Neighboring Airport</u>	
Avg. ln(fare)	5.16 (0.48)
ln(passengers)	3.81 (2.69)
Number of Threatened Routes	169
Route-Carrier-Quarters in sample	7,296

Notes: Authors' calculations using the DB1A database from the U.S. Department of Transportation.

Table 3. Basic Results

Dependent Variable: Entry defined by:	(1) ln(p) direct flight	(2) ln(p) any flight	(3) ln(q) direct flight	(4) ln(q) any flight
Southwest in both airports (no flights) t <sub>0</sub> -8 to t <sub>0</sub> -7	-.047 (.019)	-.037 (.050)	.017 (.037)	.042 (.055)
Southwest in both airports (no flights) t <sub>0</sub> -6 to t <sub>0</sub> -5	-.044 (.033)	-.010 (.039)	.000 (.051)	.006 (.059)
Southwest in both airports (no flights) t <sub>0</sub> -4 to t <sub>0</sub> -3	-.107 (.037)	-.073 (.042)	.129 (.055)	.129 (.058)
Southwest in both airports (no flights) t <sub>0</sub> -2 to t <sub>0</sub> -1	-.151 (.044)	-.097 (.050)	.125 (.085)	.061 (.075)
Southwest in both airports (no flights) t <sub>0</sub>	-.187 (.051)	-.153 (.062)	.132 (.087)	.095 (.083)
Southwest in both airports (no flights) t <sub>0</sub> +1 to t <sub>0</sub> +2	-.189 (.051)	-.221 (.066)	.095 (.086)	.102 (.087)
Southwest in both airports (no flights) t <sub>0</sub> +3 to t <sub>0</sub> +12	-.260 (.055)	-.300 (.075)	.151 (.084)	.192 (.091)
Southwest flying route t <sub>e</sub>	-.256 (.055)	-.185 (.071)	.118 (.100)	.066 (.087)
Southwest flying route t <sub>e</sub> +1 to t <sub>e</sub> +2	-.271 (.073)	-.226 (.070)	.115 (.100)	.067 (.099)
Southwest flying route t <sub>e</sub> +3 to t <sub>e</sub> +12	-.321 (.082)	-.234 (.076)	.142 (.115)	.118 (.106)
N	18,969	15,819	18,969	15,819
R <sup>2</sup>	.89	.84	.94	.93

Notes: This table shows estimates from passenger-weighted average logged fares and logged total passengers for our baseline sample. All regressions include route-carrier and quarter fixed effects. Standard errors are in parentheses and are clustered by route to account for correlation across time and across carriers on the same route. The sample includes all routes where Southwest threatens entry as defined in the text. The “Southwest in both airports” dummies denote Southwest having flights involving airports on both ends of a route previous to actually flying the route. The “Southwest flying route” dummies denote Southwest actually operating flights on the route. Columns (1) and (3) define Southwest airlines as entering a route when they establish direct service between the two airports. Columns (2) and (4) define entry as establishing either direct or change-of-plane service, where the latter is defined as having in the sample at least 40 change-of-plane Southwest tickets for the route.

Table 3A: Basic Results with Longer Event Window and Finer Time Gradation

Dependent Variable: Entry defined by:		ln(p) direct-flight
<u>Southwest in both airports (no flights)</u>		
	t <sub>0</sub> -14	-.005 (.022)
	t <sub>0</sub> -13	-.023 (.031)
	t <sub>0</sub> -12	-.052 (.033)
	t <sub>0</sub> -11	-.015 (.033)
	t <sub>0</sub> -10	.016 (.034)
	t <sub>0</sub> -9	.006 (.037)
	t <sub>0</sub> -8	-.040 (.036)
	t <sub>0</sub> -7	-.070 (.042)
	t <sub>0</sub> -6	-.069 (.043)
	t <sub>0</sub> -5	-.039 (.047)
<b>Period incumbent learns of increase in Pr(SW Entry)</b>	<b>t<sub>0</sub>-4</b>	<b>-.101 (.048)</b>
	<b>t<sub>0</sub>-3</b>	<b>-.132 (.051)</b>
	<b>t<sub>0</sub>-2</b>	<b>-.161 (.053)</b>
	t <sub>0</sub> -1	-.155 (.058)
	t <sub>0</sub>	-.195 (.066)
	t <sub>0</sub> +1	-.195 (.066)
	t <sub>0</sub> +2	-.194 (.065)
	t <sub>0</sub> +3 to t <sub>0</sub> +12	-.264 (.072)
<u>Southwest flying route</u>		
	t <sub>e</sub>	-.261 (.074)
	t <sub>e</sub> +1 to t <sub>e</sub> +2	-.275 (.095)
	t <sub>e</sub> +3 to t <sub>e</sub> +12	-.322 (.100)
N		20,645
R <sup>2</sup>		0.88

Notes: This table shows estimates from passenger-weighted average logged fares for our baseline sample, but with an expanded event window (see text for details). All regressions include route-carrier and quarter fixed effects. Standard errors are in parentheses and are clustered by route to account for correlation across time and across carriers on the same route. See also Table 3 notes for variable definitions.

Table 4. Incumbent Average Fare Responses, Adjusted for Operating Cost Proxies

	(1) Baseline	(2) Alternates 1	(3) Alternates 2	(4) cost controls
Southwest in both airports (no flights) t <sub>0</sub> -8 to t <sub>0</sub> -7	-.047 (.019)	-.050 (.040)	-.036 (.029)	-.030 (.018)
Southwest in both airports (no flights) t <sub>0</sub> -6 to t <sub>0</sub> -5	-.044 (.033)	-.076 (.058)	-.026 (.041)	-.034 (.030)
Southwest in both airports (no flights) t <sub>0</sub> -4 to t <sub>0</sub> -3	-.107 (.037)	-.144 (.065)	-.093 (.048)	-.086 (.035)
Southwest in both airports (no flights) t <sub>0</sub> -2 to t <sub>0</sub> -1	-.151 (.044)	-.208 (.079)	-.164 (.052)	-.143 (.041)
Southwest in both airports (no flights) t <sub>0</sub>	-.187 (.051)	-.237 (.083)	-.201 (.057)	-.176 (.049)
Southwest in both airports (no flights) t <sub>0</sub> +1 to t <sub>0</sub> +2	-.189 (.051)	-.235 (.085)	-.219 (.053)	-.162 (.043)
Southwest in both airports (no flights) t <sub>0</sub> +3 to t <sub>0</sub> +12	-.260 (.055)	-.257 (.095)	-.278 (.061)	-.222 (.047)
Southwest flying route t <sub>e</sub>	-.256 (.055)	-.320 (.113)	-.290 (.072)	-.236 (.056)
Southwest flying route t <sub>e</sub> +1 to t <sub>e</sub> +2	-.271 (.073)	-.314 (.106)	-.333 (.081)	-.259 (.056)
Southwest flying route t <sub>e</sub> +3 to t <sub>e</sub> +12	-.321 (.082)	-.384 (.124)	-.378 (.095)	-.312 (.063)
Operating cost control, endpoint airport 1		-	-	.404 (.059)
Operating cost control, endpoint airport 2		-	-	.297 (.064)
N	18,969	17,239	18,498	18,146
R <sup>2</sup>	.89	.84	.87	.91

Notes: All regressions are weighted by passengers and include route-carrier and quarter fixed effects. Standard errors are in parentheses and are clustered by route to account for correlation across time and across carriers on the same route. The dependent variable in columns (1) and (4) is the average log of fares for the route-carrier. The dependent variable in column (2) is the average log price of direct flights minus the price of direct flights by the same carrier between endpoint airport 1 and alternative airports that Southwest does not fly to. The dependent variable in column (3) is the price of direct flights on the route minus the price of direct flights by the same carrier between endpoint airport 2 and alternative airports that Southwest does not fly to. The operating cost controls are defined as average fares for the same carrier between the stated airport and cities that Southwest Airlines does not fly. See also Table 3 notes for variable definitions.

Table 5. Results by Type of Route

	(1) ln(p) low HHI routes	(2) ln(p) high HHI routes	(3) ln(p) nearby airport	(4) ln(q) nearby airport
SW in both airports (no flights) t <sub>0</sub> -8 to t <sub>0</sub> -7	-.012 (.036)	-.054 (.024)	.017 (.043)	-.006 (.050)
SW in both airports (no flights) t <sub>0</sub> -6 to t <sub>0</sub> -5	.048 (.057)	-.056 (.026)	.123 (.054)	-.164 (.066)
SW in both airports (no flights) t <sub>0</sub> -4 to t <sub>0</sub> -3	.035 (.068)	-.122 (.027)	.101 (.057)	-.086 (.076)
SW in both airports (no flights) t <sub>0</sub> -2 to t <sub>0</sub> -1	.031 (.075)	-.167 (.036)	.132 (.064)	-.200 (.082)
SW in both airports (no flights) t <sub>0</sub>	-.017 (.082)	-.202 (.045)	.076 (.051)	-.186 (.097)
SW in both airports (no flights) t <sub>0</sub> +1 to t <sub>0</sub> +2	-.051 (.085)	-.196 (.036)	.132 (.052)	-.225 (.105)
SW in both airports (no flights) t <sub>0</sub> +3 to t <sub>0</sub> +12	-.168 (.123)	-.266 (.044)	.170 (.076)	-.322 (.128)
SW flying route t <sub>e</sub>	-.078 (.117)	-.270 (.059)	.176 (.071)	-.340 (.137)
SW flying route t <sub>e</sub> +1 to t <sub>e</sub> +2	-.122 (.107)	-.282 (.049)	.159 (.069)	-.302 (.133)
SW flying route t <sub>e</sub> +3 to t <sub>e</sub> +12	-.151 (.125)	-.333 (.052)	.170 (.077)	-.342 (.151)
N	9498	9200	7296	7296
R <sup>2</sup>	.86	.89	.88	.89

Notes: All regressions are weighted by passengers and include route-carrier and quarter fixed effects. Standard errors are in parentheses and are clustered by route to account for correlation across time and across carriers on the same route. The dependent variable in columns (1), (2) and (3) is the average log of fares for the route-carrier. The dependent variable in (4) is the log number of passengers. Columns (1) and (2) divide the sample between routes that have HHI concentrations at or below the median in the sample and routes with HHI concentrations above the median. Columns (3) and (4) look at the price and quantity responses on routes to neighboring airports that Southwest does not fly to but are in the same market as an airport where Southwest does operate. See also Table 3 notes for variable definitions.

Table 6. Incumbent Capacity Responses: Flights, Seats, and Load Factors

	(1)	(2)	(3)	(4)	(5)
Dependent Variable:	ln(q)	ln(q)	ln(seats)	ln(flights)	ln(load factor)
Data Source:	DB1A	T100	T100	T100	T100
SW in both airports (no flights)	.014	.007	.009	.001	-.001
$t_0-8$ to $t_0-7$	(.040)	(.048)	(.040)	(.038)	(.024)
SW in both airports (no flights)	.026	-.030	-.026	-.034	-.002
$t_0-6$ to $t_0-5$	(.054)	(.070)	(.067)	(.060)	(.029)
SW in both airports (no flights)	.171	.132	.058	.051	.073
$t_0-4$ to $t_0-3$	(.058)	(.056)	(.059)	(.055)	(.030)
SW in both airports (no flights)	.170	.143	.069	.056	.071
$t_0-2$ to $t_0-1$	(.090)	(.084)	(.092)	(.079)	(.037)
SW in both airports (no flights)	.181	.242	.123	.106	.121
$t_0$	(.092)	(.094)	(.100)	(.088)	(.046)
SW in both airports (no flights)	.145	.195	.092	.074	.103
$t_0+1$ to $t_0+2$	(.091)	(.099)	(.103)	(.092)	(.049)
SW in both airports (no flights)	.205	.217	.082	.060	.135
$t_0+3$ to $t_0+12$	(.088)	(.093)	(.104)	(.095)	(.053)
SW flying route	.180	.289	.158	.115	.132
$t_e$	(.105)	(.117)	(.121)	(.110)	(.071)
SW flying route	.181	.286	.189	.144	.097
$t_e+1$ to $t_e+2$	(.103)	(.118)	(.125)	(.108)	(.063)
SW flying route	.208	.322	.204	.155	.118
$t_e+3$ to $t_e+12$	(.122)	(.130)	(.134)	(.124)	(.071)
N	3464	3464	3489	3489	3464
R <sup>2</sup>	.93	.92	.93	.92	.71

Notes: All regressions are weighted by passengers and include route-carrier and quarter fixed effects. Standard errors are in parentheses and are clustered by route to account for correlation across time and across carriers on the same route. The dependent variable in columns (1) and (2) is the log number of passengers. The dependent variable in (3) is the log of the total number of seats available on the route. In (4) it is the log number of flights actually flown. In (5) it is the share of the seats flown that are filled with passengers. The data set for column (1) is the DB1A whereas the data set for columns (2)-(5) is the T-100 as explained in the text. The sample in (1) is restricted to the same routes as in the T-100. See also Table 3 notes for variable definitions.

Table 7. Frequent Flyers and the Fare Declines

	(1) ln(p) 25th pctl	(2) ln(p) 50th pctl	(3) ln(p) 75 <sup>th</sup> pctl	(4) ln(p) leisure routes	(5) ln(p) business routes
SW in both airports (no flights) t <sub>0</sub> -8 to t <sub>0</sub> -7	-.043 (.021)	-.066 (.025)	-.048 (.032)	-.024 (.022)	-.085 (.044)
SW in both airports (no flights) t <sub>0</sub> -6 to t <sub>0</sub> -5	-.059 (.026)	-.079 (.038)	-.011 (.045)	-.034 (.021)	-.047 (.050)
SW in both airports (no flights) t <sub>0</sub> -4 to t <sub>0</sub> -3	-.100 (.028)	-.168 (.045)	-.151 (.060)	-.061 (.025)	-.147 (.053)
SW in both airports (no flights) t <sub>0</sub> -2 to t <sub>0</sub> -1	-.127 (.034)	-.189 (.057)	-.205 (.070)	-.092 (.036)	-.197 (.061)
SW in both airports (no flights) t <sub>0</sub>	-.157 (.039)	-.227 (.064)	-.241 (.084)	-.139 (.053)	-.235 (.072)
SW in both airports (no flights) t <sub>0</sub> +1 to t <sub>0</sub> +2	-.173 (.044)	-.233 (.067)	-.237 (.082)	-.142 (.039)	-.240 (.069)
SW in both airports (no flights) t <sub>0</sub> +3 to t <sub>0</sub> +12	-.220 (.053)	-.280 (.075)	-.333 (.097)	-.187 (.051)	-.335 (.077)
SW flying route t <sub>e</sub>	-.177 (.056)	-.263 (.074)	-.311 (.091)	-.158 (.060)	-.337 (.102)
SW flying route t <sub>e</sub> +1 to t <sub>e</sub> +2	-.207 (.084)	-.299 (.100)	-.310 (.110)	-.130 (.044)	-.400 (.090)
SW flying route t <sub>e</sub> +3 to t <sub>e</sub> +12	-.300 (.075)	-.353 (.101)	-.323 (.127)	-.153 (.049)	-.484 (.097)
N	18,968	18,968	18,968	8849	10120
R <sup>2</sup>	.81	.79	.82	.85	.91

Notes: All regressions are weighted by passengers and include route-carrier and quarter fixed effects. Standard errors are in parentheses and are clustered by route to account for correlation across time and across carriers on the same route. Columns (1)-(3) present quantile regressions for the 25th, 50th and 75th percentiles of prices on a route. The dependent variable in columns (4)-(5) is the average log of fares for the route-carrier. Columns (4) and (5) divide the sample according to whether or not the routes have at least one endpoint in a “leisure” destination state. See text for details. See also Table 3 notes for variable definitions.