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Actual, Adjacent, and Potential Competition

Estimating the Full Effect of Southwest Airlines

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Abstract

Southwest Airlines is frequently credited with having an important influence on the success of airline deregulation in the United States. This paper uses an original set of competition variables to estimate the extent of that influence in 1998. The estimated savings — due to actual, adjacent, and potential competition from Southwest — were $12.9 billion. Southwest's low fares were directly responsible for $3.4 billion of these savings to passengers. The remaining $9.5 billion represents the effect that actual, adjacent, and potential competition from Southwest had on other carriers' fares. These savings amount to 20 per cent of the airline industry's 1998 domestic scheduled passenger revenue and slightly more than half the fare reductions attributed to airline deregulation. From a policy perspective, these results are both troubling and encouraging. On the one hand, it is troubling to find that a large part of the fare reductions from airline deregulation is due to one carrier. On the other hand, if entry by a carrier with the appropriate characteristics can make such a difference, policies that encourage entry — for example, relaxing the restriction on entry by foreign-owned carriers — may have a large impact on passenger welfare.

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Introduction

"Probably the most significant development in the U.S. airline industry during the past decade has been the continued expansion of Southwest Airlines and the resurgence of low-fare entry generally."
Transportation Research Board (1999)

Southwest Airlines has a unique position in the US domestic aviation industry. It was one of two carriers (along with Pacific Southwest Airlines) whose low fares as intrastate carriers not regulated by the federal government led to airline deregulation in 1978.[1] Indeed, its combination of low fares, high frequency, and point-to-point service has become a model for other carriers both in the United States and abroad. As exemplified by the quote above, Southwest Airlines is often cited as a major reason for the success of airline deregulation in the United States. This paper uses an original set of competition variables to quantify the impact that Southwest Airlines has on airfares through actual, adjacent, and potential competition.

Previous Research

Previous research has estimated Southwest's aggregate impact on fares on the routes that it serves.[2] Dresner *et al.* (1996) hypothesised that the effect of Southwest (and other low-fare carriers) may be greater than previously estimated because of possible spillover effects that Southwest's service on one route has on adjacent competitive routes that involve nearby airports. They found a significant effect of service on adjacent competitive routes but did not aggregate the results to estimate the aggregate impact of Southwest. This paper's contribution is to specify the effect that Southwest may have on a route's fares in an original disaggregate way, which includes the effect of various forms of actual, adjacent, and potential competition from Southwest. The results are then aggregated to obtain an estimate of the effect that Southwest has had on airfares. This estimate is

[1] See Breyer (1982). Southwest Airlines started service in 1971 as a Texas intrastate carrier serving three Texas cities. It began interstate service shortly after airlines were deregulated in 1978. In 1999, it served 57 airports (in 29 of the 48 contiguous states) and had operating revenue of $4.7 billion, which placed it seventh among US passenger airlines.

[2] See, for example, Bennett and Craun (1993) and US Department of Transportation (1996).

compared with estimates of the fare reductions attributed to airline deregulation to gauge Southwest's role in this policy's success.

Methodology

Airfares on a route can be influenced by an airline in three ways. First, the airline can serve the route in question. Second, the airline can serve an adjacent route that consumers view as a reasonable substitute for the route in question. Third, although the airline may not serve the route in question or an adjacent route, it may still affect fares on the route if airlines lower their fares to make entry by potential competitors less attractive.[3] This could happen if the airline has a presence at the airports in question or at nearby airports.

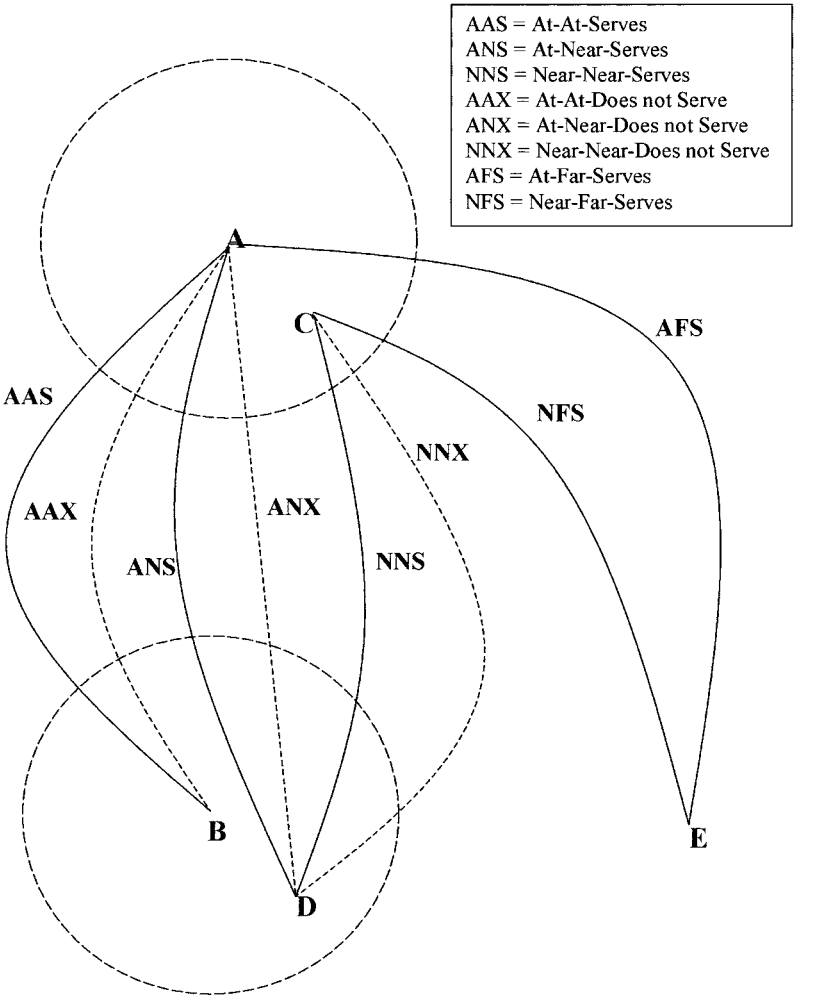
Figure 1 illustrates the various ways that an airline may affect fares on a particular route. In the figure, the route of interest is from airport A to airport B. The dashed circles around airports A and B form the boundaries of zones of influence — any carrier serving an airport within those zones may exert a competitive influence on the carriers serving the airports in question. In the diagram, airports C and D fall within the zones of A and B, respectively, and airport E is outside both zones.

The possible ways in which a carrier may affect fares on a given route A-B are:

- It may serve the route A-B (denoted by AAS, for At the origin airport, At the destination airport, and Serves the route).
- It may serve a route A-D, where airport D is "near" airport B (denoted by ANS, for At, Near, Serves).
- It may serve a route C-D, where C is near airport A and D is near airport B (denoted by NNS, for Near, Near, Serves).
- It may serve both airports A and B but not serve the route (denoted by AAX, for At, At, does not serve the route).
- It may serve airport A and airport D, which is near airport B, but not serve the route (denoted by ANX, for At, Near, does not serve the route).
- It may serve airports C and D but not serve the route (denoted by NNX, for Near, Near, does not serve the route).

[3] The role of potential competition was formalised by Baumol *et al.* (1982). In their model, the threat of entry by potential competitors disciplines those firms serving the market to price at a level that maximises consumer welfare.

Figure 1
Ways in which a Carrier may affect Fares on Route A–B



A solid line means the airline serves both airports and the route.
A dashed line means the airline serves both airports but not the route.

. It may serve a route A-E, where E is not near B (denoted by AFS, for At, Far, Serves).
. It may serve a route C-E, where C is near A, but E is not near B (denoted by NFS, for Near, Far, Serves).

In the first of these cases, the airline serves the route in question. In the next two cases, the airline provides service on adjacent routes. In the remaining five cases, a carrier provides various degrees of potential competition (the

extent of which will be estimated) by serving one or both of the airports A and B or airports nearby, but not serving routes connecting them.[4]

The Data and the Model

The primary dataset for this study was the US Department of Transportation's Ticket Origin and Destination Survey (Data Bank 1A) for the calendar year 1998, a 10 per cent sample of airline tickets, which carriers report quarterly to the Department.[5] Although the effect of Southwest Airlines will be empirically estimated below, the extent of its possible influence is shown in Table 1, which shows the percentage of domestic passenger miles flown on routes in each of the categories above. To avoid double counting, Southwest's (potential) influence on each route was classified into the highest category for which it qualified. During 1998, Southwest was in a position to (potentially) influence fares on the routes it served and on adjacent routes amounting to 44.8 per cent of domestic passenger miles flown. In addition, in its role as a potential competitor, it was in a position to (potentially) influence fares on routes accounting for an additional 49.4 per cent of domestic passenger miles. Thus, Southwest was in a position to potentially influence fares on routes comprising 94 per cent of domestic passenger miles.[6]

[4] The last two cases are considered as potential competition even though the carrier offers service on A-E or C-E because airport E is outside the zone of influence for the A-B route.

[5] In order to be reasonably assured that the tickets for a particular trip reflect travel from one origin to one destination, only tickets with one (directional) destination were used. Round trips had to return to the initial point of departure (with no ground segments, i.e., "open jaw" tickets). Only one-way tickets with two or fewer coupons (i.e., flight segments) and round-trip tickets with two or fewer coupons on the outbound and return legs were used. Further, only tickets involving airports in the 48 contiguous states were used. Finally, tickets that were coded with the generic codes for Chicago, Detroit, New York City, and Washington, DC were omitted because it was not possible to identify the airport actually used.

[6] What characterises those routes that are beyond any (potential) impact of Southwest? The 20 most heavily travelled routes (based on passenger miles) that Southwest did not (potentially) influence in 1998 (amounting to 24 per cent of the passenger miles of that unaffected group) involved routes between the following 13 airports: Atlanta, Buffalo, Charlotte, Denver, Hartford, LaGuardia, Memphis, Minneapolis-St. Paul, Newark, Raleigh-Durham, Richmond, Philadelphia, and Pittsburgh. Eight of these airports are hubs for major airlines. Eleven are in the eastern US. One is slot constrained. (In 1999, Southwest entered Hartford and Raleigh-Durham.)

Table 1
Competitive Profile of Southwest Airlines in 1998

Category	*Variable*		*Percentage of Domestic Passenger Miles*
Actual Competition			44.8%
	At-At-Serves	21.0%	
	At-Near-Serves	18.0%	
	Near-Near-Serves	5.7%	
Potential Competition			49.4%
	At-At-Does not Serve	6.5%	
	At-Near-Does not Serve	2.7%	
	Near-Near-Does not Serve	0.1%	
	At-Far-Serves	30.7%	
	Near-Far-Serves	9.4%	
Total			94.2%

Source: Author's calculations. See text for a detailed explanation of the variables. Calculations are based on a zone of influence with a 75-mile radius. Totals may not add due to rounding.

The standard approach to assessing the effect of competition — both actual and potential — on airfares is to estimate a fare equation.[7] In a fare equation, the average fare on a route is regressed on measures of actual and potential competition and other control variables that are believed to influence the cost and demand characteristics of the route. Here, quarterly data from the 1,000 most heavily travelled routes in 1998 were used to estimate a fare equation to assess the effect of Southwest Airlines on fares.[8]

The Dependent Variable

For each ticket in the sample, the price each passenger paid was reduced by the amount of ticket taxes and passenger facility charges (PFCs).[9] Average one-way fare (logarithm) was then calculated for each route in the sample.[10]

[7] This fare equation may be regarded as a reduced form equation derived from a structural model. See, for example, Bailey and Panzar (1981), or Morrison and Winston (1995).

[8] The 1,000 routes account for 70 per cent of passengers and 67 per cent of passenger miles in the full dataset containing more than 29,000 routes.

[9] During the first three quarters of 1998, the federal domestic ticket tax was 9 per cent of the ticket price plus $1 per flight segment. During the fourth quarter of 1998, the tax was 8 per cent plus $2 per segment. 290 airports assessed PFCs during 1998; all but one airport charged the statutory maximum of $3 per enplanement; one airport charged $2.

[10] Because of possible coding errors in the data carriers submit to the Department of Transportation, the US General Accounting Office's (1990) fare screen was used to screen out fares that seemed too high. In order to keep frequent flier tickets, a low-fare screen was not used. The effect on the results of omitting frequent flier tickets is discussed below in the section on sensitivity.

The Competition Variables

As above, Southwest's (potential) influence on each route was classified into the highest category for which it qualified. In addition, competition variables giving the number of carriers from each group serving the route were included for three other groups of carriers:[11] Low-Fare carriers (other than Southwest), Major carriers (other than Southwest), and Other carriers.[12] A zone of influence with a radius of 75 miles was used because it provided the best fit compared with zones of 25, 50, 100, and 125 miles.[13]

Control Variables

Although we are primarily interested in the effect that Southwest Airlines has on fares, it is important to control for other influences in order that we are reasonably certain that the competition variables capture just that, rather than some other effect.

Distance:

Other things being equal, we expect fares to be higher the longer the trip because costs are higher. The logarithm of the (great circle) distance from the origin to the destination was used.

Density:

Because of fixed station costs and economies of aircraft size, airline service is characterised by economies of density.[14] An airport is classified into one of four "hub" categories (Large, Medium, Small, and Non) based on its

[11] A carrier was considered as serving a route if it had at least a 10 per cent share of the route's passengers. Attempts to estimate an equation with a complete set of competition variables to capture the effect of adjacent and potential competition for major, low fare, and other carriers resulted in implausible estimates for all competition variables.

[12] The Low-Fare carriers identified by the US Department of Transportation that were operating during 1998 (other than Southwest) were AirTran, American Trans Air, Frontier, Kiwi, ProAir, Reno, Spirit, Tower Air, Vanguard, and Western Pacific. The US Department of Transportation defines a Major carrier as one with annual revenue over $1 billion. In 1998, the Major (passenger) carriers (in addition to Southwest) were Alaska, American, America West, Continental, Delta, Northwest, Trans World, United, and US Airways. The Other carriers used in this analysis were Casino Express, Eastwind, Hawaiian, Midway, and Midwest Express. Carriers with fewer than 1,000 sampled passengers during 1998 were not assigned a competition variable, nor were trips involving changing airlines, i.e., interline connections.

[13] Dresner *et al.* (1996) used a 50-mile radius to define adjacent competitive routes. Sensitivity results for zones of 25, 50, 100, and 125 miles are reported below.

[14] See, for example, Caves *et al.* (1984).

share of enplanements nationwide.[15] Since there are four hub classifications, a given route is in one of ten possible origin-hub-destination-hub classifications (for example, Large-Small). To control for density, nine dummy variables were used representing all but one of the possible combinations of service between the four airport hub classifications. (A Non-Hub-Non-Hub variable was not used because there were no routes in the top 1,000 in that category.) Because dummy variables were included for all hub categories in the sample, a separate constant term was not included.

Slots:
Four airports in the United States have limits on the number of takeoffs and landings that may take place during any given hour. To account for the effect on fares of the demand restrictions at these so-called "slot-controlled" airports, four dummy variables were included for the four airports: Chicago O'Hare; New York Kennedy and LaGuardia; and Washington Reagan National. The variable equalled one if the airport was on the route in question, and zero otherwise.

Percentage Business:
Airlines use yield management to charge business travellers higher fares than pleasure travellers. Thus, other things being equal, trip purpose is expected to affect airfares. Data used were the percentage of air travellers travelling between the states where the origin and destination airports were located, whose trip purpose was business.[16]

Concentrated Hubs:
Previous research (see, for example, Borenstein, 1989) has shown that other things being equal, fares at concentrated hub airports are higher

[15] Those airports that accounted for 1 per cent or more of passenger enplanements were classified as Large Hubs; those enplaning 0.25 per cent or more but less than 1 per cent were classified as Medium Hubs; airports enplaning 0.05 per cent or more but less than 0.25 per cent were classified as Small Hubs; airports enplaning less than 0.05 per cent were classified as Non Hubs. These classifications were determined based on the US Department of Transportation's Airport Activity Statistics data (Form 41, Schedule T-3, Data Bank 22) for 1998. This definition differs from the US Federal Aviation Administration's definition of hub class in that here airport level enplanements were

[16] This was calculated from data in the US Department of Transportation's (Bureau of Transportation Statistics), 1995 American Travel Survey. Given that state-level data were used and that the data come from an earlier year, this variable is likely to be exogenous.

than at other airports. This analysis uses the US General Accounting Office's (1990) definition, in which an airport was considered concentrated if it was among the top 75 in the country in terms of passenger enplanements and one carrier accounted for 60 per cent or more of enplaned passengers at the airport, or two carriers accounted for 85 per cent or more of enplaned passengers at the airport. The resulting variable equalled one if one or both of the airports involved on the route were concentrated using the above definition.[17]

Regional Effects:
To account for unobserved effects that are regional in nature (such as weather), a "Sun-Belt" variable was created.[18] The variable equalled the number of airports in the Sun Belt on the route in question, that is 0, 1, or 2.

Quarterly Effects:
To control for quarterly fixed effects, three dummy variables for quarters 1–3 were used.

Estimation Results

Full regression results are in the Appendix. Although we are interested in the Southwest competition variables, plausible values for the other

[17] This was calculated from the enplanements data in the US Department of Transportation's Airport Activity Statistics data (Form 41, Schedule T-3, Data Bank 22) for 1998.

[18] The definition of "Sun-Belt" states that provided the best fit to the data was a group including California, Nevada, Arizona, New Mexico, Texas, Louisiana, Mississippi, Alabama, and Florida. Alternatively, the results did not change qualitatively when regional effects were captured using eight of the following nine US Department of Transportation regional variables: Region 1 (the base case): Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; Region 2: New York, New Jersey, and Pennsylvania; Region 3: Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia; Region 4: Illinois, Indiana, Michigan, Ohio, and Wisconsin; Region 5: Alabama, Kentucky, Mississippi, and Tennessee; Region 6: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota; Region 7: Arkansas, Louisiana, Oklahoma, and Texas; Region 8: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming; Region 9: California, Oregon, and Washington.

coefficients will lend credence to the model. The quarterly dummies reveal that fares are higher in quarter 1 than in the other periods (perhaps due to a smaller fraction of price-sensitive vacation travellers in that period). The density dummies are all statistically significant, but their relative magnitudes do not appear to show any interesting relationship. Two of the slot coefficients have positive signs, but only one (O'Hare) is statistically significant at the 5 per cent level. The coefficient for Washington National is negative, but is not statistically significant. Finally, the coefficient for New York's Kennedy Airport has a negative sign and is statistically significant. However, slots at Kennedy are not in effect throughout the entire day and, given its greater distance from New York population centres, it may cater to more price-sensitive pleasure travellers. The distance coefficient indicates that, as expected, fares increase less than proportionately with distance, other things being equal, due to the fixed flight costs that are independent of the length of the flight (such as takeoff and landing). The concentrated hub dummy indicates that fares are about 4 per cent higher on routes involving concentrated hubs, even after controlling for route competition and other effects. The percentage business coefficient indicates that fares are 28 per cent higher on routes with 75 per cent business travellers compared with otherwise comparable routes with 25 per cent business travellers.[19] The sun-belt variable indicates that fares involving flights to or from that region are 6 per cent lower than elsewhere, all else being equal. The competition variables for carriers other than Southwest seem quite reasonable: additional competition lowers fares, and Low-Fare and Other carriers have a larger impact on fares than Major carriers.[20] On balance, the model seems to produce plausible results.

Estimation results for the Southwest Airlines competition variables of interest are reported in Table 2. All the estimated coefficients are significantly different from zero at the 1 per cent level. Although all coefficients are precisely estimated, it is useful to see if their relative magnitudes seem reasonable before we look at their absolute magnitude.

The relative magnitudes of the actual competition variables seem reasonable because the magnitude of the coefficient declines as the service

[19] Calculated as follows: exp(0.75*coefficient)/exp(0.25*coefficient)-1.

[20] The differential impact of Major carriers on fares compared with the relatively large impact of Southwest and other Low-Fare carriers is consistent with the findings of Bailey *et al.* (1985), Strassman (1990), and Windle and Dresner (1995).

Table 2
Estimation Results for Southwest Airlines Competition Variables

Category	*Variable*	*Coefficient*	*Standard Error*	*Effect on Fares**
Actual Competition				
	At-At-Serves	−0.620	0.023	−46.2%
	At-Near-Serves	−0.306	0.023	−26.4%
	Near-Near-Serves	−0.167	0.029	−15.4%
Potential Competition				
	At-At-Does not Serve	−0.401	0.027	−33.0%
	At-Near-Does not Serve	−0.140	0.033	−13.1%
	Near-Near-Does not Serve	0.188	0.033	20.7%
	At-Far-Serves	−0.125	0.021	−11.8%
	Near-Far-Serves	−0.067	0.024	−6.5%

Source: Author's calculations. See Appendix for full regression results and main text for a detailed explanation of the variables.
*Given that the regression equation explains the logarithm of fares, the effect on fares is exp(coefficient)-1.

becomes less of a substitute for travel on the route in question. The same is true for the potential competition variables, with the exception of Near-Near-Does not Serve.[21] It is also reasonable that the magnitude of the effect of actual competition is greater than the effect of potential competition in the two cases where a plausible effect of potential competition was estimated (that is At-At-Serves *vs.* At-At-Does not Serve, and At-Near-Serves *vs.* At-Near-Does not Serve).[22] Thus, the relative magnitudes of the coefficients seem reasonable.

As far as the absolute effects are concerned, when Southwest serves a route (At-At-Serves), fares are 46 per cent lower than on otherwise comparable routes that it does not serve. If it serves an adjacent route (At-Near-Serves and Near-Near-Serves), fares are from 15 to 26 per cent below otherwise comparable routes. Potential competition from South-

[21] The effect of Southwest in the Near-Near-Does not Serve case is to *raise* fares by 21 per cent. It should be noted, however, that this estimate is based on only four quarterly observations for one route in the sample (Dayton-Washington Reagan National).

[22] Morrison and Winston (1987) estimated the impact (for all types of carriers combined) of actual competition on a route (AAS in this paper's terminology) and potential competition (defined as carriers serving one or both airports on a route, but not the route itself, AAX, ANX, and AFS in this paper's terminology). They found that a potential competitor had 1/3 the effect on passenger welfare that one actual competitor had. Here, depending on the specific type of (comparable) potential competition considered, the effect on fares of Southwest as a potential competitor ranges from 50 to 71 per cent of the effect of actual competition from Southwest.

west is most effective when it serves both endpoints of a route but not the route itself (lowering fares by 33 per cent) and least effective when it only serves one airport that is near one of the airports in question, in which case fares are reduced by 6 per cent.[23]

Simulation

The model was used to estimate the impact that Southwest Airlines has on airfares. For each route in the complete data set of all routes (not just the top 1,000) passenger expenditure (predicted fare times number of passengers) was estimated with and without Southwest Airlines.[24] The results in Table 3, decomposed into the effect of each variable, show the savings to air travellers in 1998 because of Southwest.[25] Not surprisingly, the biggest impact of competition from Southwest comes when it serves the route in question, lowering fares by nearly $7 billion. When the effect of competition on adjacent routes is taken into account, the total effect of actual competition from Southwest increases to nearly $10 billion. Adding the effect of Southwest as a potential competitor raises the total impact of Southwest Airlines to $12.9 billion. Given that Southwest had passenger revenue of nearly $4.0 billion in 1998, and that its presence on a route lowers fares on that route by an estimated 46.2 per cent, Southwest's low fares were directly responsible for $3.4 billion of savings to passengers. The remaining $9.5 billion represents the effect that actual, adjacent, and potential competition from Southwest had on other carriers' fares. These

[23] When a comparison is possible, these results are comparable with Dresner *et al.* who found that fares are 41 per cent lower when Southwest serves a route and 8 to 36 per cent lower when Southwest serves an adjacent route.

[24] The simulation only used those coefficients for Southwest that were statistically different from zero at the 5 per cent level of significance. Because Southwest's enplanements, passenger miles, and revenue in the sample ranged from 9.9 per cent to 10.1 per cent of their respective population values, the results of the simulation were multiplied by ten to obtain the figures reported in the Table.

[25] These savings do not reflect the change in consumer surplus but represent how much more costly the trips currently taken would be without Southwest. Assuming a constant elasticity of demand, the change in consumer surplus would be $10.9 billion with an elasticity of (minus) 0.75, $9.4 billion with an elasticity of 1.5, and $7.2 billion with an elasticity of 3.0. Furthermore, this analysis is short-run in nature and does not consider that if Southwest did not exist, other carriers may have taken its place on some of the routes served. If it was replaced on all the routes it serves, the savings attributable to Southwest would be $9.9 billion if replaced by a low-fare carrier, $11.3 billion if replaced by an "other" carrier, and $12.5 billion if replaced by a major carrier. (This calculation only considers the direct effect of carriers other than Southwest because, as noted in footnote 11, it was not possible to estimate a plausible equation with a complete set of competition variables for all types of carriers.)

Table 3
Decomposition of Savings Attributed to Southwest Airlines in 1998 (billions of dollars)

Category	*Variable*	*Effect*
Actual Competition		9.58
	At-At-Serves	6.55
	At-Near-Serves	2.56
	Near-Near-Serves	0.47
Potential Competition		3.30
	At-At-Does not Serve	0.95
	At-Near-Does not Serve	0.18
	Near-Near-Does not Serve	−0.01
	At-Far-Serves	1.76
	Near-Far-Serves	0.42
Total Savings		12.88

Source: Author's calculations. See text for a detailed explanation of the variables.

savings amount to 20 per cent of all domestic airline passenger revenue and imply that Southwest is responsible for 53 per cent of the fare reductions attributed to airline deregulation.[26]

Sensitivity of Results

To assess the sensitivity of the results to the radius of the assumed zone of influence and to the inclusion of frequent flier tickets, nine additional regressions were estimated with the radius of the zone set at 25, 50, 75, 100, and 125 miles, including and excluding frequent flier tickets. As shown in Table 4, the estimated savings attributed to Southwest Airlines range from $8.73 billion to $13.80 billion. Both including and excluding frequent flier tickets, the estimated savings increase as the radius of the zone of influenced is increased, reach their maxima at 50 miles, and then decrease. Estimated savings including frequent flier tickets are always less

[26] This is based on an update to the estimate in Morrison and Winston (1995) of the fare reductions attributable to airline deregulation. For 1998, fares were 28 per cent lower than an estimate of what they would have been had regulation continued. Given actual industry domestic passenger revenue of $64 billion in 1998, this amounts to savings of $24.4 billion. $12.9 billion is 53 percent of $24.4 billion. To the extent that the estimate of the fare reductions from deregulation is understated, Southwest's contribution is overstated. But any plausible estimate of the fare reductions from deregulation still shows Southwest making a significant contribution. Morrison and Winston (1995) also found that fare reductions represented about 2/3 of the benefits to passengers from airline deregulation.

Table 4
Sensitivity of Savings Attributed to Southwest Airlines in 1998 (billions of dollars)

Radius (miles) of Zone of Influence	*Including Frequent Flier Tickets*	*Excluding Frequent Flier Tickets*
25	9.62	10.00
50	13.19	13.80
75	12.88	13.30
100	11.00	11.45
125	8.73	9.15

Source: Author's calculations using estimated coefficients that were significant at the 5 per cent level.

than if they are excluded. Thus, the results reported above (which were chosen because they yielded the best fit for regressions that included frequent flier tickets) are reasonably robust.[27]

Comparison with Other Studies

Table 5 compares the results of this study with the results of three previous studies of the aggregate impact of Southwest Airlines on airfares. These previous studies assessed Southwest's effect on the routes that it served,

Table 5
Comparison with Other Studies

Study	*Year of Data*	*Amount that Southwest Lowers Fares as a Percentage of Industry Domestic Passenger Revenue*	*Southwest's Share of Domestic Scheduled Revenue Passenger Miles*
Morrison and Winston (1995)	1988–92	8.5% on routes served	2.9% (1990)
Bennett and Craun (1993)	1992	5.6%–6.7% on routes served	4.0% (1992)
U.S. DOT (1996)	1995	8.4%–10.1% on routes served	5.9% (1995)
Morrison (2000)	1998	10.2% on routes served 4.7% on adjacent routes 5.2% from potential competition	6.9% (1998)

Sources: Listed above and Air Transport Association (various issues) and Southwest Airlines (www.southwest.com).

[27] If the simulation is limited to only those 1,000 routes used in the regression equation, the effect is $9.7 billion.

but did not capture the additional effects of competition on adjacent routes or from potential competition.

Based on a fare model and entry and exit models, and using data from 1988-92 for the 1,000 most heavily travelled routes, Morrison and Winston (1995) estimated that if Southwest Airlines exited the airline industry, fares nationwide would increase by 8.5 per cent after five years, even after taking into account the subsequent entry that would probably occur.

Bennett and Craun (1993) found that if fares on Southwest's routes in 1992 were raised to the level of fares on non-Southwest routes, industry revenue would rise by $2.5-$3.0 billion (holding traffic constant), which amounts to 5.6-6.7 per cent of 1992's domestic scheduled passenger revenue.

The US Department of Transportation (1996) estimated that low-fare carriers saved passengers $6.3 billion during the four quarters ending in 1995:3. If we conservatively assume that Southwest's and other low-fare carriers' effect on fares is the same, because Southwest accounted for 71 per cent of low-fare carriers' revenue passenger miles during the four quarters studied, Southwest's effect would be $4.5 billion, amounting to 8.4 per cent of domestic scheduled passenger revenue. If, on the other hand, we assume that Southwest's presence on a route exerts a stronger influence on fares as indicated by the estimates in this paper, Southwest's effect rises to $5.4 billion, amounting to 10.1 per cent of domestic scheduled passenger revenue.[28]

The Table also shows Southwest's relative size during the time periods covered by these studies. Given that Southwest accounted for a larger share of the industry in 1998, and that this study includes both the effect of competition on adjacent routes and the effect of potential competition from Southwest, which the other aggregate studies did not, the results seem reasonable, although dramatic.[29]

Summary and Conclusion

This paper reports estimates of the savings that Southwest Airlines has brought to air travellers in the United States during 1998 using an original set of actual, adjacent, and potential competition variables. The estimated savings due to competition from Southwest was $12.9 billion. Southwest's

[28] Here, we assume that the effect of a Southwest passenger mile is 2.25 times more powerful than other low-fare carriers' passenger miles; 2.25 is the ratio of the effect of Southwest (1-exp(-0.62)) to the effect of other low-fare carriers (1-exp(-0.23).

[29] The US Department of Transportation (1996) notes that the impact of low-fare carriers has been growing at an increasing rate.

low fares were directly responsible for $3.4 billion of these savings to passengers. The remaining $9.5 billion represents the effect that actual, adjacent, and potential competition from Southwest had on other carriers' fares. These savings amount to 20 per cent of the airline industry's 1998 domestic scheduled passenger revenue and slightly more than half of the fare reductions attributed to airline deregulation — a sizable impact from a carrier that accounts for about 7 per cent of the industry's domestic scheduled passenger miles. From a policy perspective, these results are both troubling and encouraging. On the one hand, it is troubling to find that a large part of the fare reductions from airline deregulation is due to one carrier — albeit one, along with Pacific Southwest Airlines, whose performance as an intrastate carrier not regulated by the Civil Aeronautics Board provided a natural experiment that contributed to the passage of the Airline Deregulation Act. On the other hand, if entry by the "right" carrier can make such a difference, policies that encourage entry — for example relaxing the restrictions on entry by foreign-owned carriers-may have a large impact on passenger welfare.

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Appendix

Ordinary Least Squares Regression Results

Dependent Variable: Logarithm of Average Fare
White Heteroskedasticity-Consistent Standard Errors

Variable	Coefficient	Standard Error	t-Statistic	Probability
Quarter 1 Dummy	0.052490	0.010539	4.980753	0.0%
Quarter 2 Dummy	0.015028	0.009772	1.537867	12.4%
Quarter 3 Dummy	0.000123	0.009831	0.012493	99.0%
Large Hub-Large Hub Dummy	2.377770	0.059735	39.805390	0.0%
Large Hub-Medium Hub Dummy	2.364472	0.058763	40.237720	0.0%
Large Hub-Small Hub Dummy	2.268900	0.056298	40.301470	0.0%
Large Hub-Non Hub Dummy	2.053422	0.065934	31.143380	0.0%
Medium Hub-Medium Hub Dummy	2.305377	0.059215	38.932040	0.0%
Medium Hub-Small Hub Dummy	2.247348	0.061191	36.726570	0.0%
Medium Hub-Non Hub Dummy	2.217791	0.068890	32.193100	0.0%
Small Hub-Small Hub Dummy	1.956237	0.054875	35.648990	0.0%
Small Hub-Non Hub Dummy	2.177449	0.089147	24.425440	0.0%
Washington Reagan National Dummy	−0.022675	0.021961	−1.032517	30.2%
New York Kennedy Dummy	−0.159651	0.026972	−5.919129	0.0%
New York LaGuardia Dummy	0.029887	0.015915	1.877973	6.1%
Chicago O'Hare Dummy	0.068581	0.018123	3.784230	0.0%
Percent Business Travel	0.494438	0.024715	20.005290	0.0%
Distance (logarithm)	0.408168	0.007605	53.674420	0.0%
Number of Airport in Sunbelt	−0.057146	0.006638	−8.608938	0.0%
Concentrated Hub Dummy	0.055875	0.009511	5.875008	0.0%
Southwest: At-At-Serves	−0.619880	0.022826	−27.156370	0.0%
Southwest: At-Near-Serves	−0.306484	0.023236	-13.190140	0.0%
Southwest: Near-Near-Serves	−0.167483	0.028573	−5.861661	0.0%
Southwest: At-At-Does Not Serve	−0.401170	0.027317	−14.685750	0.0%
Southwest: At-Near-Does Not Serve	−0.140334	0.033032	−4.248364	0.0%
Southwest: Near-Near-Does not Serve	0.188314	0.032628	5.771554	0.0%
Southwest: At-Far-Serves	−0.124500	0.020706	−6.012689	0.0%
Southwest: Near-Far-Serves	−0.066610	0.023775	−2.801657	0.5%
Number of Low Fare Carriers on Route	−0.233511	0.010366	−22.525530	0.0%
Number of Major Carriers on Route	−0.029259	0.004696	−6.230184	0.0%
Number of Other Carriers on Route	−0.117270	0.020069	−5.843354	0.0%

Number of Observations = 4,000
$R^2 = 0.739$

Source: Author's calculation. See text for a detailed explanation of the variables.