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The Potential Impact of Airline Deregulation on Feeder Routes in the Far West

Lawrence Shepard

In anticipation of the air transportation regulatory reform act, this paper assesses the consequences of deregulating the airline industry. Particular attention is devoted to the impact of deregulation on air fares, travel demand, and flight frequency for relatively short feeder routes connecting small cities and rural centers. On the basis of a sample of routes in the far western states, it appears that deregulation would raise fares on routes shorter than 100 miles while lowering prices on longer trunk routes connecting major metropolitan areas. Flight frequency on particular routes would be curtailed by approximately 28 percent as airlines substituted price competition for nonprice rivalry under a new regulatory regime.

Pending legislation contemplates broad deregulation of the airline industry.[1] An abundance of research has addressed the consequences of such a policy on prices and service in long-haul trunk lines connecting major metropolitan areas [e.g., Miller; Keeler; Douglas and Miller]. However, consumer economists and policy analysts have devoted less attention to estimating the impact of regulatory reform on feeder flights that serve smaller cities and rural centers. Traditionally rural residents have benefited from the Civil Aeronautics Board's fixed fare structure which subsidizes and promotes short interstate flights to remote areas. For this reason, deregulation measures designed to foster price competition may raise fares and reduce service for rural air passengers.

In order to shed some light on that question, this article examines the market for passenger travel on relatively short, regulated and unregulated air routes. After discussing the industry's competitive structure, the paper develops an econometric model of the supply of and demand for airline travel. Frequency of service is also incorporated into the analytical framework. Data from five western states are employed to assess the potential effects of deregulation on passenger travel, air fares, and flight frequency on feeder routes serving residents of nonmetropolitan areas.

The Airline Industry

Regulation of interstate air service falls within the purview of the Civil Aeronautics Board (CAB). Since its founding in 1938, the Board's actions have been reflective of its charge to foster competition among airlines only "to the extent necessary." To this end, the agency has tightly controlled passenger fares and routes. The entry of potential competitors has also been restricted. As a result no new trunk line carriers have been established since the 1930's despite dramatic

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[1]The Ninety-fourth Congress has considered H.R. 10261 and H.R. 14604 while the Senate is acting on S. 2551, S. 3364, and S. 3536. Concurrently, the Civil Aeronautics Board has embarked upon an experiment in regulatory reform (U.S. Civil Aeronautics Board). The prospects for substantial regulatory reform are further enhanced by President Carter's appointment of Alfred Kahn as CAB chairman. A regulatory economist of some note, Kahn has been an outspoken critic of CAB policies (Kahn, pp. 209-220).

growth in domestic air travel [U.S. Congress, p. 3]. Furthermore, the Board has openly discouraged competition between feeder and trunk line carriers.[2]

While protected from outside competition and guaranteed attractive fares by the CAB, carriers are under strong pressure to increase passenger loads. For example, the chairman of a large airline indicates that adding just one passenger to each of the company's flights would raise corporate after-tax profits by approximately $18 million from an average annual level of $3.6 million over the last ten years [Dallos]. In an attempt to achieve higher passenger loads, carriers engage in extensive nonprice competition as exemplified by inflight entertainment, bountiful meals, "free" champagne, reservation networks, designer-clad hostesses, and in the past, use of electric shavers, typewriters, and sleeper seats. This behavior is consistent with theoretical precepts[3] and has been empirically verified in other industries where prices are fixed either through regulation or private conspiracy [e.g., Kahn; Phillips; Shepard].

One of the major modes of air carrier nonprice competition is through the type of planes flown. Because the CAB prohibits carriers who operate older equipment from charging lower fares, firms are motivated to purchase aircraft as modern as any used by their competitors in order to protect their market shares [Caves, pp. 231-32]. Consequently first generation jets or their "stretch jet" progeny have been introduced on almost all interstate routes. This may impose special costs on rural passengers who frequent feeder routes where jet aircraft are less efficient than smaller propeller planes due to the shorter distances involved and the lower population density in rural regions. Nevertheless, the airline industry continues to compete through widespread introduction of the most modern planes, as illustrated by the rapid adoption of wide-bodied aircraft, to which many of the industry's financial difficulties have been attributed ["Insanity Comes to Air Fares Again"]. Environmental considerations permitting, supersonic passenger aircraft promise yet another episode in this type of rivalry.

The industry's distinctive competitive scenario finds carriers also vying for passengers through flight frequency. Airlines act as though the firm which offers the most flights on a route will capture a disproportionate market share [Taneja; Renard]. As a result, most city-pairs are connected by multiple daily flights even though these planes often fly half empty. Miller presents compelling evidence that such competitive overscheduling is responsible for the chronic excess capacity that exists among airlines (pp. 108-114). The capacity problem is so severe that the CAB's *target* load factor (passenger-miles expressed as a proportion of total seat-miles) is only 55 percent [Council of Economic Advisors, p. 154]. Load factors are significantly higher on unregulated intrastate routes [Keeler, p. 421].

Intensive nonprice rivalry in the regulated sector of the air passenger service industry has the effect of raising costs and, consequently, fares. By comparing relatively competitive California intrastate routes with interstate traffic in the Northwest Corridor, Jordan estimates that fares are from 47 to 89 percent higher where they are determined by the CAB rather than by competition (p. 400). Employing a long-run cost model, T. E. Keeler independently demonstrates that CAB controlled fares reflect a 48 to 84 percent markup over estimated unregulated

[2]In the Bonanza-TWA Route Transfer case the CAB argues, "We recognize that some competition between local service carriers and trunk lines is inevitable but we intend not only to minimize such competition but to prevent its development to the greatest feasible extent;" 10 CAB 893 (1949).

[3]In the words of Alfred E. Kahn, "If the minimum rate regulation is effective, it will almost certainly hold the price above the marginal costs of some producers, to which competition would otherwise drive it.... But if competition is sufficiently strong, potentially, to drive price down to that level, it will ordinarily be sufficiently strong to induce the suppliers, confronting a price above their marginal costs, to seek other, nonprice methods of producing additional sales." The theory of nonprice competition where prices are regulated is more fully elaborated by Stigler and, recently, White.

fares. Keeler concludes that with fares set at high cartel levels, the airlines have competed away profits through excess capacity. On the basis of similar studies economists, with uncharacteristic unanimity of opinion, argue that deregulation of air transportation would make the industry's service mix more reflective of consumer preferences and reduce fares on interstate trunk lines [e.g., Eads; Jordan; Kahn].

It is not at all clear, however, that pending legislation designed to foster price competition among carriers would yield lower fares on less frequently traveled feeder routes to rural and other nonmetropolitan areas. Under its policy of cross-subsidization, the CAB has in the past forced interstate airlines to extend service to those areas and to charge fares that are below costs on those flights [Caves, pp. 401-402, 435-436]. Resulting losses are offset by higher revenues associated with the fares fixed by the CAB on densely traveled trunk lines between large cities. The rationale for cross-subsidization is to assure air service on routes that are otherwise economically unviable. Note that cross subsidization in favor of rural citizens is encountered in other regulated markets. For example, within a given region telephone, power, freight, and postage rates seldom account for the higher costs of serving more sparsely populated areas [Kahn, pp. 143, 190-2; Turvey].

While residents of remote regions must travel on feeder routes each time they fly, people living in major urban centers use those subsidized routes only when they have nonmetropolitan destinations. For this reason, cross-subsidization has in the past effected a transfer from urban to rural passengers. Clearly regulatory reform aimed at reversing CAB cross-subsidization carries the potential of altering this scheme. More specifically, under a regime of market-determined prices carriers would likely attempt to reduce fares and expand market shares on profitable trunk routes while raising rates and restricting service on unprofitable feeder connections. On feeder routes flight frequency would continue to fall and fares would rise until the marginal returns to carriers equaled those prevailing on trunk lines. This market response has been anticipated by legislators from nonmetropolitan areas who have voiced opposition to air transportation regulatory reform proposals [U.S. Congress, House Committee on Commerce]. However, only fragmentary quantitative evidence exists about the degree to which deregulation would alter air service to remote areas.

The Model

In order to analyze the potential impact of deregulation in rural regions an econometric model of the air passenger service market was developed. The model consists of three structural equations simultaneously determining the demand for, supply of, and frequency of air passenger service:

$$\text{Quantity} = f(\text{Price}, X_1 \ldots X_m)$$
$$\text{Price} = f(\text{Quantity, Frequency, Regulation}, Y_1 \ldots Y_n)$$
$$\text{Frequency} = f(\text{Quantity, Regulation}, Z_1 \ldots Z_o)$$

where $X_1 \ldots X_m$, $Y_1 \ldots Y_n$, and $Z_1 \ldots Z_o$ are, respectively, additional factors influencing travel demand, travel supply, and flight frequency. The model was specified as being linear in logarithms. This formulation allows direct observation of relevant elasticities and conforms with the specifications of previous researchers (e.g., Mathematica).

In the transportation literature travel demand is commonly analyzed using gravity models in which travel between two cities is assumed to vary with their relative proximity and some measure of their "mass" [Quandt]. Mass, measured for example by the product of the cities' populations, is said to directly influence demand since the potential for travel increases with the number of possible interactions between residents of the city-pair. On the other hand, demand will be lower the greater is the separation of two cities as measured by distance or travel time.

In the current study it is hypothesized that the annual number of passengers (Q) demanding air travel between a city-pair depends upon the product of the cities' populations (M) and the distance between them (D). Air fares (P) and the population-weighted mean income of the cities (Y) are also introduced as determinants of travel:

$$\ln Q = \alpha_0 + \alpha_1 \ln P + \alpha_2 \ln M + \alpha_3 \ln D + \alpha_4 \ln Y$$

Travel demand is expected to vary inversely with price and distance and directly with mass and income. Results of previous research suggest that the income elasticity (α_4) will exceed 1.0 [Verleger, p. 453]. These expectations about estimated coefficients are summarized in Table 1.

Airline operating costs have been shown to depend primarily upon traffic, length of routes, and type of aircraft [Keeler, pp. 403-412]. For this reason, supply price is assumed to vary with quantity of travel (Q), distance (D), and flight equipment (A). Variable A is assigned a value of 1 for routes serviced by propeller aircraft and a value of zero for jet equipment. Theoretical considerations suggest that the coefficient on quantity will be positive while the comparative efficiency of jet aircraft should give A a negative impact on price. Supply price per mile has consistently been observed to decline as distances increase [Eads, pp. 35-39]. This "fare taper" arises because many operating costs as well as ticketing, passenger processing, baggage handling, and runway costs do not vary proportionately with flight length. Thus, the coefficient on D is expected to have a positive value of less than one in logarithmic specification of the supply function. With other things equal, increased flight frequency reduces load factors and raises costs. The number of daily flights (F) is accordingly introduced into the equation. The airlines' regulatory environment is specified as a final determinant of price. To capture the effects of CAB cross-subsidization, the variable R and the multiplicative term RlnD are included in in the relationship

$$\ln P = \beta_0 + \beta_1 \ln Q + \beta_2 \ln F + \beta_3 R + \beta_4 R\ln D + \beta_5 \ln D + \beta_6 A$$

where R has unitary value on CAB regulated interstate routes and zero value elsewhere.

Due to cross-subsidization it is hypothesized that regulated fares are systematically lower on short routes and higher on longer routes than a competitive market would sustain. This relationship would be confirmed by a significant negative coefficient on R and a positive coefficient associated with RlnD. In this case, regulation's impact on supply is neutral for the distance D′ where

$$\beta_3 + \beta_4 \ln D' = 0 \text{ or } D' = e^{-\beta_3/\beta_4}.$$

In the absence of empirical evidence, it is difficult to anticipate the value of D′. However, for cross-subsidization to be viable for the airline system, D′ must be substantially smaller than the traffic-weighted mean length of routes in the U.S., which is approximately 756 miles.[4] One further set of restrictions on the coefficients arises: due to the fare taper, β_4 should lie between zero and unity as should the sum $\beta_4 + \beta_5$ which represents the elasticity of price with respect to distance on regulated routes. The null hypothesis that regulation does not systematically influence

TABLE 1: Expectations about Empirically Estimated Coefficients

Variable	Demand equation (lnQ)	Supply equation (lnP)	Flight frequency equation (lnF)
lnP	$\alpha_1 < 0$		
lnM	$\alpha_2 > 0$		
lnD	$\alpha_3 < 0$	$1 > \beta_5 > 0$	$\gamma_3 < 0$
lnY	$\alpha_4 > 1$		
lnQ		$\beta_1 > 0$	$\gamma_1 > 0$
lnF		$\beta_2 > 0$	
R		$\beta_3 < 0$	$\gamma_2 > 0$
RlnD		$1 > \beta_4 > 0$	
RlnD, lnD		$1 > \beta_4 + \beta_5 > 0$	
RlnD, R		$0 < e^{-\beta_3/\beta_4} < 756$	
lnA		$\beta_6 < 0$	
lnN			$\gamma_4 > 0$

[4]This measure is based on the 100 most frequently traveled routes (U.S. Civil Aeronautics Board 1974).

fares would be substantiated by coefficients on R and the multiplicative term that do not depart significantly from zero.

For the supply relationship, the frequency with which airlines offer flights on particular routes depends foremost on the quantity of travel (Q) [Douglas and Miller, pp. 663-668]. In addition, one would expect to encounter more flights on routes served by a larger number of competiting carriers (N). If the propensity of airlines to offer multiple flights is attenuated on more costly, long distance routes, coefficient γ_3 in the relationship

$$\ln F = \gamma_0 + \gamma_1 \ln Q + \gamma_2 R + \gamma_3 \ln D + \gamma_4 N$$

would carry a negative sign. A significant, positive coefficent on R would confirm that regulation exacerbates scheduling competition.

It has been demonstrated that cross-sectional analysis of air travel should be restricted to relatively homogeneous city-pairs since demand conditions vary markedly between submarkets in the transportation network. [Verleger, p. 440]. Accordingly, the sample used to test this model includes the 54 direct routes of less than 600 miles which are served by certificated air carriers in California, Oregon, Washington, Idaho, and Nevada. The mean distance of sample flights is 292 miles. Most routes in the sample originate in cities with fewer than 75,000 residents. Over half of these cities are agricultural or lumbering centers in California and the Pacific Northwest. A total of 24 of the 54 routes cross state boundaries and, therefore, are subject to CAB regulation. While intrastate flights operate under state regulation, an abundance of research bears evidence that intrastate passenger service is relatively competitive [Levine]. With the exception of four routes served by propeller driven aircraft (for which A = 1), first generation jet aircraft was in use. Traffic and demographic data were taken from government publications while fare, scheduling, distance, and aircraft information was acquired from industry sources [U.S. Civil Aeronautics Board 1974; Donnelly; U.S. Bureau of the Census]. In all cases 1974 figures were employed.

Previously cited researchers have largely ignored questions of simultaneity in the determination of travel demand and air fares. This may reflect an assumption that changes in market parameters are set by regulatory resolve rather than by market forces. In addition, empirical evidence indicates that quantity of travel on trunk lines bears a weak statistical relationship to the level of fares [Verleger, p. 454]. However, these factors appear to be less applicable to feeder routes both because competition is intense on many local lines and because less expensive modes of transportation represent closer substitutes for air transportation on short journeys. Thus, quantity demanded, supply price, and frequency of service are assumed to be simultaneously determined. The relationships are estimated using the two stage least squares technique.

Empirical Results

A significant degree of the variation in the endogenous variables Q, P, and F is explained by the model.[5] All coefficients in the estimated equations carry expected signs (Table 2). However, the coefficients on D in the demand equation, A in the supply equation, and D in the frequency of service equation are not significantly different from zero at the 95 percent level of confidence.

In the demand expression, mass appears to be a primary determinant of travel. The coefficient of 1.02 compares with Alcaly's estimates of 1.06 and 1.49 (p.69). The estimated demand elasticity of 0.23 compares with a mean value of 0.12 on elasticities reported by Verleger. The weaker responsiveness of demand to price changes noted by analysts employing single equation models may arise at least in part from their failure to account for

[5]Coefficients of determination for the reduced form equations for Q, P, and F were .32, .37, and .29, respectively.

TABLE 2: Empirical Estimates for Interstate and Intrastate Feeder Routes in the Far West (1974)

Demand

$$\ln Q = -0.23 \ln P + 1.02 \ln M - 0.61 \ln D + 1.50 \ln Y + 5.50$$
$$(0.07) \quad (0.24) \quad (.49) \quad (0.36) \quad (0.84)$$

Supply

$$\ln P = 0.057 \ln Q + 0.28 \ln F - 1.39 R + 0.30 R\ln D + 0.32 \ln D - 0.060 A + 6.27$$
$$(0.034) \quad (0.07) \quad (0.58) \quad (0.10) \quad (0.06) \quad (0.090) \quad (2.29)$$

Frequency

$$\ln F = 0.14 \ln Q + 0.28 R - 0.014 \ln D + 1.56 \ln N + 0.10$$
$$(0.04) \quad (0.16) \quad (0.010) \quad (0.13) \quad (0.10)$$

Q = annual number of passengers between city-pair
P = lowest daytime one-way fare on route
M = product of the city's populations (1,000,000's)
Y = population — weighted average annual income
F = number of direct daily flights connecting city-pair
R = regulatory environment (0,1)
A = type of aircraft (0,1)
N = number of competitors

supply interactions. As expected, the income elasticity exceeds 1.0 verifying that an increasing share of increments to income is spent on air transportation. Distance, which serves as an impedence factor in travel demand studies, carries a negative sign but is of marginal statistical significance. The coefficient −0.61 lies between Alcaly's values of −.21 and −.79. In separate analyses, Richmond and Belmont conclude that distance is of questionable influence on air travel demand.

Increased output is associated with higher prices in the supply equation. When combined with the negative demand relationship between price and quantity, this result tends to affirm the validity of studying this market in a simultaneous framework. As Table 2 indicates, high prices also coincide with increased flight frequency. The coefficient on distance, lying between zero and one, captures the fare taper. Type of aircraft apparently has little bearing on fares, suggesting that on short feeder routes the efficiencies commonly associated with jet equipment are not realized.

The most frequently serviced routes, of course, are those where demand is greatest. Note, however, that a 10 percent increase in travel coincides with the addition of only 1.4 percent more flights. In contrast, frequency of service is highly responsive to participation by additional competitors. For example, in response to a 10 percent rise in the number of airlines on a typical route it is estimated that the industry adds between 15 and 16 percent more flights. This response on the part of carriers is consistent with evidence cited above that market shares are disproportionately high for firms having the most flights on a route.

The cross-sectional analysis provides tangible evidence of the impact of CAB regulation. The last equation in Table 2 indicates that interstate routes are typically served by 28 percent more flights than similar intrastate connections. Based on sample means, regulated routes appear to have approximately three more flights daily. While the CAB oversees fares and routes, flight frequency is not subject to direct regulation except on infrequently traveled short routes that would not be served at all without CAB intervention. The larger number of flights on interstate routes must therefore be attributed to the competitive behavior of firms operating under a regime of regulated prices.[6] Accordingly,

[6]In alternative specifications of the flight frequency equation, the multiplicative term RlnD proved insignificant. This result may reflect, on the one hand, the CAB's insistance that very short, economically unviable routes receive some flight service and, on the other, the propensity of airlines to over-service profitable longer routes.

deregulation can be expected to have the effect of significantly reducing the frequency of flights on feeder routes to rural and nonmetropolitan locations.

Higher fares also prevailed on CAB controlled routes. Using mean values of D, prices were on the average 42 percent higher than competitively established rates. This difference is somewhat lower than the 48 to 84 percent estimate by Keeler whose sample was dominated by long-haul flights. The average markup on routes in Keeler's cost study was 57 percent and the mean distance was 709 miles. While this distance falls outside the range of the present study, the empirically derived supply equation implies that regulation on routes of this length would raise fares by approximately

$$\frac{\partial P}{\partial R}\ \frac{1}{P} = -1.39 + .30(\ln 709) = 58 \text{ percent.}$$

This response is very much in line with Keeler's estimate. Note that the estimated fare differential is even greater for the traffic-weighted mean distance of U.S. trunk routes, 756 miles.

The results obtained above confirm that CAB regulation, while increasing the average level of fares, has differential impacts on flights of differing length. The positive coefficient on the multiplicative term RlnD indicates that regulated fares rise in relation to competitively determined rates as distance traveled increases. Regulation has a neutral impact on flights of

$$D' = e^{-(-1.39)/.30} = 103 \text{ miles}$$

where interstate and intrastate fares are estimated to coincide. The CAB's rate structure subsidizes travelers on shorter routes by charging lower fares than a competitive market would sustain while taxing passengers on longer flights. This impact of regulation is captured in Figure 1 which illustrates the derived relationship between fares and distance in regulated and unregulated markets at mean values of Q, F, and A.

Conclusions

This analysis gives insight into policy questions surrounding the quantitative effects of deregulating interstate air passenger transportation. First, the data verify the theoretical prediction that non-price competition would diminish under a regime of unregulated prices. As a result, interstate air carriers could be expected to curb the number of flights offered on feeder routes by from 25 to 30 percent in the absence of CAB control. Moreover, service on some routes would likely be eliminated altogether. This effect has been conceded by the airlines in their vigorous defense of existing regulatory practices [U.S. Congress, House Commiteee on Commerce]. Fare reductions averaging more than 40 percent are also potentially associated with reduced federal regulation of air transportation pricing and entry. However, the data suggest that under competition prices would rise on routes of less than approximately 100 miles. While these represent a small portion of all interstate flights, they typically connect

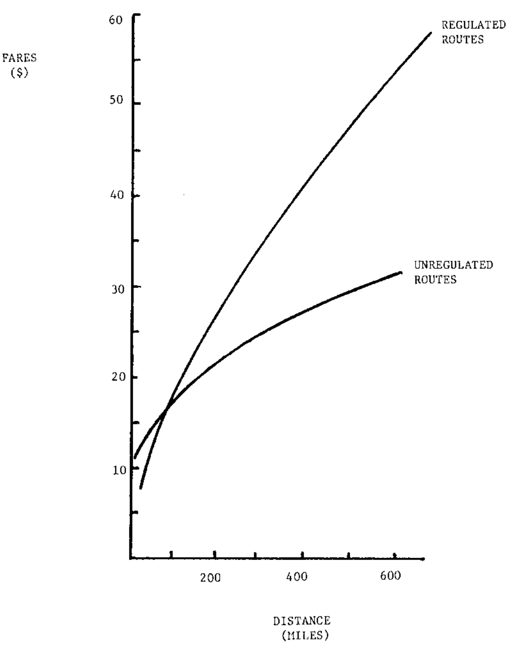

FIGURE 1: Estimated relationships between fares and distance travelled on air routes in the Far West (1974)

small cities and rural centers. Further work will be required to deduce more precisely the impact of deregulation on commerce, development and migration in these areas. However, it is clear that the costs of deregulation would be concentrated on persons residing outside major metropolitan areas while its benefits would accrue to interurban travelers. As contemplated in pending legislation, regulatory reform can in general be expected to produce a fare structure on interstate routes which more nearly approximates intrastate fares, as carriers engage in price competition and reduce their services to a level more reflective of consumer preferences.

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