AIRLINE CONSOLIDATION AND CONSUMER WELFARE

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INTRODUCTION

When airline deregulation was enacted in 1978, the conventional wisdom held that the industry would develop along the lines successfully demonstrated by the thriving intrastate carriers who operated independently of federal route and fare regulation. These were small carriers who specialized in point-to-point service, and because they were so much more cost-efficient than the regulated interstate carriers, many scholars saw their mode of service as a model for the national air transport system that would be forged by competitive forces. This, of course, has not happened.

Mergers and bankruptcies have reduced the number of national carriers from twenty-three to eight in the years since 1978, and none of the surviving eight provides point-to-point service. Instead, dense hub-and-spoke network systems have become the norm. The point-to-point route configuration has been the exception, and is confined to a few regional airlines, the most conspicuous of which is Southwest.

We explain this outcome with a model in which consumers care not only about price but also about service, as measured by scope of operations or network density. Consumers value more dense networks because they facilitate more convenient service. Our model suggests that the service-enhancing effects of employing large-scale networks have outweighed the potential price-increasing effects of having a smaller number of competing carriers. Our model concludes that a welfare gain accrues to consumers as a result of the more consolidated market structure.

For a range of plausible parameter estimates, our model suggests that the socially optimal number of national carriers may be even smaller than the current number. Thus, the continued evolution to a competitive airline industry equilibrium may involve further consolidation. Furthermore, the industry is likely to remain consolidated, no matter how large the market becomes. The intuition is that service-enhancing costs attract consumers, and firms therefore have incentives to increase such expenditures as long as the market expands. As a result, only a small number of major players can stay in the market, no matter how large the market becomes.

Our model finds that the market equilibrium is one in which carriers earn sufficient profits to provide them with capital, but not to earn monopoly rents. Thus, com-

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petition is not destructive in equilibrium. Efficiency has required the number of national carriers to shrink. Public policy makers have a role to play within this context: both antitrust policy and bankruptcy policy should be exercised so as not to impede welfare-enhancing consolidations in the airline industry. Responding to political demands to nurse sick airlines through lengthy Chapter 11 proceedings is counterproductive. Global consolidation and partnerships are likely to be efficient and therefore should be encouraged rather than discouraged by governments.

A MODEL OF AIRLINE COMPETITION

The Importance of Network Effects

The significance of unrealized network and other scale economies in the airline industry was not understood at the time airlines were deregulated. The industry appeared to lack economies of scale. While it was recognized that regional (local service) carriers had a higher cost structure than national (trunk) carriers, it was thought that this would be eliminated by permitting free entry and exit. As Alfred Kahn [1988] once expressed it, airplanes are "marginal costs with wings" that can readily be deployed in newly opened markets.

Although it was known that there was a competitive value associated with control of feed traffic (passengers originating in smaller communities), it was also thought that low-cost, no-frills, point-to-point services, such as those offered by the former intrastate airlines, could be replicated across the country. Fixed costs in the industry were modeled as constant (exogenous). With fixed costs constant, more and more firms can enter as the market increases, and the level of concentration decreases accordingly. Hence, many economists expected that there would be a large number of firms in a deregulated airline industry equilibrium.[1]

By eliminating entry restrictions, deregulation freed carriers to restructure their operations. Rather than the linear routes often awarded by regulators, airlines configured their route systems to optimize the flows through their networks. A new operating design, the hub-and-spoke delivery system, became standard for the major carriers in the industry. As pointed out by Carlton, Landes and Posner [1980], if there is an intermediate stop on a trip, passengers much prefer single-carrier service to changing airlines. Single-carrier services often involve no change of plane. Even when a change of plane is required, the connection and navigation times within the hub airport are shorter and the hassle is less than with a change of carriers. The advantage of hub-and-spoke systems to consumers is that airlines provide single-carrier services to many cities that do not have enough traffic to support frequent nonstop services. Winston [1993] has found that the frequency improvement of the wider range of flights far outweighs the added transit costs to consumers of the one-stop hub-and-spoke service.[2]

Because of the importance of hub-and-spoke network systems to airlines' competitive positions, we set up an airline model in which airlines endogenously determine the scale (e.g., coverage and connection) of their hub-and-spoke network systems. In addition, the costs associated with setting up the network systems are treated as fixed costs which are invariable with the number of passengers actually transported. We model the airline competition as a two-stage service-price game. At the first stage, each airline chooses its hub-and-spoke network scale. At the second stage, each airline selects a price that maximizes its profits, given its network scale.

In early models of the airline industry, an airline's competitive position was determined by models which focused on individual city-pair markets rather than on the coverage and connection of its network [Douglas and Miller, 1974; Dorman, 1976; Panzar, 1979]. In our two-stage model, we account for the service-enhancing effect of a large-scale network on passenger demand. We demonstrate that the setup and development costs of an airline's network and other systems play significant roles in determining industry structure. Our model is inspired by a series of papers which have examined industrial concentration from the viewpoint of product differentiation [Shaked and Sutton, 1983; 1987; Sutton, 1991; Gabszewicz, Shaked, Sutton and Thisse, 1981; Bresnahan, 1992].

Contestability theory has also played a role in airline deregulation [Bailey, 1981; Baumol, Panzar and Willig, 1982; Bailey and Baumol, 1984]. It was recognized that many city-pair markets would remain concentrated even after deregulation, as the demand for services would be insufficient to support competition within these markets. Yet it was hoped that free and easy entry and exit into such markets would serve to discipline price. The fixed, service-enhancing costs, such as hub-and-spoke network investments, which have been undertaken by the airline industry in the post-regulation period involve substantial sunk costs, which make the hoped-for contests by potential entrants less likely. Thus, it is not surprising that evidence has been mounting that airline markets are not as contestable as had been hoped [Bailey and Panzar, 1981; Call and Keeler, 1988; Bailey, Graham and Kaplan, 1985; Morrison and Winston, 1987; Borenstein, 1989, 1992].

Both the entry barrier and service quality enhancing effects of the airlines' hub-and-spoke networks have been recognized in the literature [Morrison and Winston, 1987; Levine, 1987; Borenstein, 1989; 1991; Berry, 1990; 1992]. For example, Berry's early study [1990] incorporated passenger preferences in a product differentiation model of airlines. It found that passengers are willing to pay a premium for services that relate to airlines' network coverage. In his subsequent paper, Berry [1992] estimated the effects of airlines' network coverage on airline city-pair profitability. However, the welfare implications are left open. We address both welfare and market structure implications in our model.

A Two-Stage Model with Open Entry

Consider n airlines providing differentiated flight services. The airlines compete by choosing a hub-and-spoke network scale s_i and price p_i, $i = 1, 2, \ldots, n$. We model the competition as a two-stage game. At the first stage, each airline chooses s_i. At the second stage, each airline chooses its price p_i, given its s_i, $i = 1, 2, \ldots, n$. Our presentation here is simplified to identical consumers and symmetric airlines. Hendricks, Picione and Tan [1995] study a case of symmetric demands and costs for a single airline selecting both price and network design. Liu [1993] considers a case of asymmetric service differentiation and its relation to industry concentration.

We first derive consumer demand from consumer utility equations. Airline flights are viewed by consumers as substitutes, with features that differentiate them from one another. A representative consumer is assumed to have the following consumer surplus function:

$$CS = \sum_{i=1}^{n} (\alpha + s_i)x_i - (1/2)(\beta \sum_{i=1}^{n} x_i^2 + \gamma \sum_{j \neq 1}^{n} x_i x_j) - \sum_{i=1}^{n} p_i x_i . \tag{1}$$

where n is the number of differentiated airlines; p_i and s_i are price and a measure of network scale of airline i; x_i is the number of trips taken by this individual consumer on airline i; and α, β, and γ are parameters with $\alpha > 0$, $\beta > \gamma > 0$, and $1 > (\gamma/\beta) > 0$. As γ/β moves from 1 to 0, the services by the n airlines are less and less substitutable. This utility function is selected because it yields a standard, linear consumer demand which increases with network scale and decreases with price. As Daughety [1988] points out, this kind of functional form is frequently used in differentiated product models. It allows us to derive simple and explicit results.[3]

For a given network scale s_i's and price p_i's for the various airlines, the consumer chooses a level of trips x_i, $i = 1, 2, ..., n$, that maximizes his or her utility (1). This would yield a system of demand equations:

$$p_i = \alpha + s_i - \beta x_i - \gamma \sum_{j \neq 1}^{n} x_i, i = 1, 2, ..., n . \tag{2}$$

Reiss and Spiller [1989] used this type of inverse demand equation in their empirical study of airline entry behavior. Each x_i is uniquely determined from equation (2) in terms of s_i's and p_i's. Assume that there are Z identical consumers. It follows that the total demand for airline i is simply Zx_i, $i = 1, 2, ..., n$.

When the n airlines are symmetric, s_i's and p_i's are all equal to a common value s and p, respectively, all the x_i's are also equal to each other. Denote the common x_i as x. Equation (2) then reduces to

$$x = (\alpha + s - p)/[\beta + (n - 1)\gamma]. \tag{3}$$

We denote ε_p as the negative of the price elasticity of demand. Using Equation (3), we have

$$\varepsilon_p = -(p/x)(\partial x/\partial p) = p/\{x[\beta + (n - 1)\gamma]\}$$

which gives

$$p = x[\beta + (n - 1)\gamma]\varepsilon_p. \tag{4}$$

For a given n and s, ε_p gives the percentage change of a consumer's travel demand for one airline if the airlines' common price p is increased by one percent. Because the Z consumers are identical and the n airlines are symmetric, $[(p/x)(\partial x/\partial p) = (p/Znx)(\partial Znx/\partial p)]$. ε_p is also the percentage change of the total market demand for the n airlines relative to the percentage change of the common price p. Conceptually, the elasticity of demand discussed is the industry's elasticity. However, because of the symmetry assumption, the elasticity is the same for the firm as for the industry.

We now write out the airline's profit function and derive the equations that combine to determine the equilibrium price, network scale, and the number of airlines. For simplicity, assume that the airlines have a constant unit passenger cost c and a fixed network cost Ks_i^u, where $i = 1, 2, ..., n$, and K and u are positive parameters. This cost formulation is consistent with the finding that the airline cost structure displays an increasing return to density as described in earlier studies [Caves, Christensen and Tretheway, 1984; Kumbhaker, 1990]. With these notations, the airline profit function can be written as

$$\pi_i = (p_i - c)Zx_i - Ks_i^u. \tag{5}$$

The equilibrium price p_i is determined from the second stage of airline competition where each airline takes the network scale s_i as given and maximizes profit π_i by setting price p_i. Adopting the Nash equilibrium concept, Liu [1994] demonstrates how to write out the first order condition on equation (5) and obtain the p_i that maximizes π_i, $i = 1, 2, ..., n$. Note that the equilibrium p_i's are functions of the given s_i's, which are yet to be determined. When s_i's are all equal to s, p_i's are also equal to a common value, denoted as p. This is given by

$$p = \{c[\beta + (n - 2)\gamma] + (\beta - \gamma)(\alpha + s)\}/[2\beta + (n - 3)\gamma]. \tag{6}$$

The equilibrium network scale s_i is determined from the first stage of airline competition where each airline chooses s_i to maximize the profit π_i, realizing that its price p_i, selected at the second stage, is directly affected by all the s_i's. It is tedious but straightforward to write out the first order condition. For the symmetric case where s_i's are all equal to s, the first-order condition is

$$\{2Z[\beta + (n - 2)\gamma][2\beta^2 + 3(n - 2)\beta\gamma + (n^2 - 5n + 5)\gamma^2](\alpha + s - c)\}/\{[\beta + (n - 1)\gamma][2\beta + (n - 3)\gamma]^2 = Kus^{u-1}. \tag{7}$$

It is easy to find that $u > 2$ would ensure the existence of the first-stage network-scale symmetric equilibrium. Together with the second-stage price equilibrium, this also ensures a subgame perfect equilibrium.

The number of airlines, n, is determined from the zero profit condition, which arises from the free entry condition. We consider only the symmetric case, where $s_1 = s_2 = ... = s_n = s$. The zero profit condition is simply $Zx(p - c) = Ks^u$, which can be rewritten as

$$(p - c)/p = Ks^u/(Zxc + Ks^u) = \delta_f. \tag{8}$$

As indicated by equation (8), δ_f is defined as the ratio of an airline's fixed network cost to its total costs. Using equations (3), (4), and (6) to replace $(p - c)/p$, equation (8) can be restated as:

$$(\beta - \gamma)/[\beta + (n - 2)\gamma] = \varepsilon_p \delta_f. \tag{9}$$

Equation (9) allows us to empirically examine the relationship between the number of airlines in equilibrium and the ratio of fixed network costs as determined by the airlines' network scales. As a comparison with equation (9), it is noted that the equilibrium number of firms in a standard, Cournot competition (i.e., competing by product quantity rather than price) with free entry is given by $1/(\varepsilon_p \delta_f)$.[4] This number corresponds to the n given by equation (9) when γ/β is equal to 0.5.

The equilibrium network scale s has an interesting property. Using equations (7) and (8), it is possible to show that, as market size Z increases, the equilibrium network scale s increases (so does the fixed network cost), and the equilibrium number of airlines n decreases. In other words, large market demand actually leads to a smaller equilibrium number of airlines. This is consistent with a general result obtained by Sutton [1991]. The intuition is that the firms have incentives to spend more (i.e., higher fixed costs) on services in larger markets because the returns are higher in larger markets. As a result, larger markets do not necessarily engender more competitors. This result seems to be characteristic of the airline industry: the number of airlines has continued to decline over the years, even though travel demand has expanded.

It is also worthwhile to point out that the case for consolidation may be even stronger than the one made in our model, which rests solely on demand-side network economies. There may also be economies on the cost side, if greater network density would improve utilization of aircraft, departure lounges, gates, counter space, ground crews, maintenance facilities, even pilots and flight attendants. We have assumed, to the contrary, that variable cost is constant while network fixed cost increases with size. Thus, in our model, average costs increase with network size.

Comparison to a Constrained Welfare Maximization Regime

In this section, the airline network scale, price, and the number of carriers that maximize consumer welfare are derived. They are then compared with those obtained in the previous section under the competitive equilibrium regime. The difference in modelling comes about because firms equate benefits to profits when making their decisions. Welfare maximization also takes into account the benefits to consumers. We consider a constrained welfare-maximization regime in which the total consumer surplus (*TCS*) is maximized subject to the constraint that the airlines' profits, (i.e., total producer surplus (*TPS*), are zero). Parallel with the last section, only cases of identical consumers and symmetric airlines are examined.

Using the consumer surplus equation (1) and demand equation (3), the total consumer surplus, *TCS*, can be written as

$$TCS = \frac{Zn(\alpha + s - p)^2}{2[\beta + (n - 1)\gamma]}. \tag{10}$$

Using the airline profit equation (5) and the demand equation (3), producer surplus for the n airlines totals

$$TPS = \frac{nZ(p - c)(\alpha + s - p)}{\beta + (n - 1)\gamma} - nKs^u. \tag{11}$$

We now derive the equations that determine s, p, and n under the constrained welfare-maximization regime where *TCS* is maximized subject to the constraint that *TPS* = 0. If *TPS* = 0, we obtain

$$[Z(p - c)(\alpha + s - p)]/Ks^u = \beta + (n - 1)\gamma. \tag{12}$$

Using equation (12) to eliminate n from the *TCS* equation (10), and then maximizing this with respect to p and s give the following two first-order conditions:
With respect to p

$$2Z(p - c)^2(\alpha + s - p) = (\beta - \gamma)(\alpha + s - c)Ks^u. \tag{13}$$

With respect to s:

$$2Z(p - c)(\alpha + s - p) = (\beta - \gamma)[Ks^u + (\alpha + s - p)uKs^{u-1}]. \tag{14}$$

Denote s_o, p_o, and n_o as the network scale, price and the number of airlines obtained from equations (12), (13), and (14) under the constrained welfare maximization regime. Further, denote s_e, p_e, and n_e as the network scale, price and the number of airlines obtained from equations (6), (7) and (8) under the competitive equilibrium regime. Liu [1994] has shown that the following relations hold.

$$s_o > s_e; \tag{15a}$$

$$n_o > n_e; \tag{15b}$$

$$p_o > p_e. \tag{15c}$$

These inequalities show that the network scale under the competitive equilibrium is smaller, the number of airlines larger, and the price lower than under welfare maximization regime.[5] The result of (15a) stems from the model assumption that average cost rises with network size. If average cost declined instead with network size, the industry would be characterized by a natural monopoly. This does not mean, of course, that it would necessarily be best to have only a single national airline. The survival of at least a few fringe carriers might stimulate sufficient innovation to compensate for the costs of smaller networks.

The intuition behind our welfare result is that airlines, when they set their network scale under the equilibrium regime, equate the benefits with their effects on profits; they ignore benefits to consumers. Consequently, the equilibrium network scale is lower than the one that maximizes welfare. As a result of this lower equilibrium network scale and consequently lower fixed network setup costs, more carriers are able to enter the market than under the welfare maximization regime. The price under the equilibrium regime is in turn lower than that under the welfare maximization regime.

Given that the welfare maximization regime maximizes consumer welfare, it is clear that the total consumer welfare levels are lower under the competition equilibrium regime than under the welfare maximization regime (both have a zero profit condition). The inequalities expressed by equation (15) thus imply that decreasing network scale from the equilibrium level s_e would allow more airlines and lower prices in the market, which seems to be more competitive, but in fact lowers total consumer welfare because it moves further away from the welfare optimal regime. On the other hand, increasing network scale from the equilibrium level s_e would allow fewer airlines and higher prices in the market, which seems to be less competitive, but in fact increases total social welfare because it moves closer toward the welfare optimal equilibrium.

This result is interesting as well as counterintuitive. It implies that, as the deregulated airline industry has made its structural transition toward a concentrated equilibrium through a series of mergers and bankruptcies, total consumer welfare has been increasing.[6] In other words, the service-enhancing effect of employing large-scale networks has outweighed the potential price-increasing effect of the smaller number of competing carriers.

EMPIRICAL RESULTS AND POLICY IMPLICATIONS

The Empirical Evidence

Equation (9) allows us to find the equilibrium number of carriers in the industry if we know numerical values for three key variables: (1) the price elasticity of demand; (2) the degree to which fixed network investments are an important feature in the industry; and (3) the degree to which customers view airline services as substitutes. Rather than focus on point estimates, we have searched the literature to find ranges of the key variables that appear realistic for the airline industry. There is evidence on all three.

Consider first demand elasticities of air passenger travel, ε_p. A recent survey of the empirical literature on transportation demand conducted by Oum, Waters and Yong [1992, Table 3] includes thirteen air-travel demand studies. Demand elasticities are classified by data types and nature of travel. The elasticity estimates range from 0.4 to 4.5, with the majority of the figures falling within a narrower range. Results suggest that demand elasticities differ significantly among different fare classes (first class, standard economy, and discount fares) and distance (long versus short haul). This is hardly surprising since price-sensitive holiday travelers form the majority of passengers on long-haul routes, whereas business travelers predominate on short-haul routes. In general, demand for business travel is less elastic than for leisure travel, and elasticity estimates from cross-section data are higher than from time-series data. Oum, Waters and Yong believe that demand for business travel is less than unity while that of holiday traffic is greater than unity, although the empirical estimate is not unambiguous. For the following calculation, ε_p is depicted as falling within the range 0.8 to 1.6, with the lower end of the range corresponding to business and short-distance travel, and the upper end of the range leisure and long-distance travel.

Note that the fixed cost ratio δ_f can be written as $1 - [Zxc/(Zxc + Ks^u)]$, and $[Zxc/(Zxc + Ks^u)]$ is the airline's cost elasticity with respect to its output Zx, while holding the fixed cost Ks^u (i.e., its network scale) constant. The inverse of this elasticity is defined by Caves, Christensen, and Tretheway [1984] and Kumbhaker [1990] as the airline's returns to density (*RTD*). It thus follows that $\delta_f = 1 - (1/RTD)$. Caves, Christensen, and Tretheway estimated *RTD* for both trunk and local airlines during the period 1970 to 1981. Kumbhakar extends the *RTD* estimates to 1984. Based on their estimates of *RTD* and the above relationship between δ_f and *RTD*, we find that δ_f averages around 16 percent for the deregulated period (1979-84). We use a range of 10 percent to 20 percent in our calculation.

The third variable, γ/β, measures the degree of substitution among the airlines. Here we use an empirical study of Reiss and Spiller [1989, Appendix, Table A1].[7] These authors model the determinants of competition on direct and indirect airline routes. On the demand side, they find that direct and indirect flights are substitutes, but not perfect substitutes. Several factors affect the degree of substitutability between services, including distance and whether the route has significant tourist traffic. They make estimates for a variety of competitive models, such as maximum-likelihood estimates assuming oligopolistic or perfect cartel competition in indirect service. We adopt for our purposes estimates of the demand parameters evaluated at sample averages for Bertrand cross-service competition. In the following calculation, we present the equilibrium number of airlines under the assumed value $\gamma/\beta = 0.6$.[8]

Using the above ranges of ε_p, δ_f, and $\gamma/\beta = 0.6$, the number of airlines n in the industry is calculated from equation (9). The results are presented in Table 1. The numbers in the table are not truncated to integers. Therefore, a number like 4.5 would indicate that four airlines can coexist in a market with positive profits but one more airline (with equal size) in the market, i.e., a total of five, would bring a net loss to every airline.

As seen from Table 1, for a given price elasticity of demand, the number of airlines would decrease if the airlines increase spending on fixed network costs. For a given network cost level, as price elasticity increases, Table 1 shows that the number of airlines decreases. This is because airlines cannot charge high prices when the travel demand becomes very elastic. As a result, airlines would have low revenues

TABLE 1
Number of Airlines in Equilibrium
Degree of Substitution: $\gamma/\beta = 0.6$

Demand Elasticity	Nework Fixed-Cost Ratio $\delta_f = 0.10$	0.20
$\varepsilon_p = 0.8$	8.7	4.5
1.2	5.9	3.1
1.6	4.5	2.4

and few of them can stay in the market. Similarly, when γ/β increases, airlines become more substitutable. Consequently, prices would be lower and fewer airlines could coexist. For example, when $\gamma/\beta = 0.8$ instead of 0.6, the upper left entry in Table 1 would be 3.9 carriers rather than 8.7, and the lower right entry would be 1.5 carriers rather than 2.4.

The Transition to a More Concentrated Industry

The U.S. airline industry in 1978 was constrained by regulators to consist of specialized (local, national, intrastate, charter, or international) carriers. Nineteen airlines (eleven national and eight local service carriers) had a 98 percent market share. The model we have presented estimates that a deregulated equilibrium would have far fewer carriers. Reality has mirrored our results.

The transition toward more concentration began almost immediately. The consolidations have been of two main types. First, regional carriers that wished to have more of a national profile have consolidated. For example, three local service carriers with largely non-overlapping catchment areas—North Central, Southern, and Hughes Air West — merged to form Republic. Similarly, two regional trunks — Delta and Western — combined, joining route systems lying primarily east and west of the Mississippi, respectively. Second, trunk carriers have bought out regional carriers that had strength at the trunk's hub airport. As described in the literature [Bailey and Williams, 1988; Moore, 1986; Borenstein, 1992], the merged entity had both local feed strength and national reach. Examples include the mergers between Northwest and Republic (with Minneapolis-St. Paul as the hub) and between Trans World and Ozark (with St. Louis as the hub).

Virtually all surviving carriers adopted the strategy of becoming full-service, nationwide, and now global, carriers.[9] Thus, our assumption of symmetric airline strategy is reflective of the reality that has emerged over the past decade and a half. Some carriers became survivors through growth and merger, while others had one or more bouts with bankruptcy, often followed by exit.

The speed at which national firms are exiting the industry is in line with data on survival in other industries after the introduction of major change. Suarez and Utterback [1995] find that transition in market structure after the introduction of a dominant design is long. It takes from 15 to 30 years to reach an eventual equilibrium of roughly one quarter the initial number of firms. In the airline industry, the transition has been from twenty-three carriers in 1978 to eight national carriers in 1994. So the speed of adjustment following airline deregulation does not seem out of line with that in other industries which have experienced fundamental change. In terms of our theory, it is likely to be an efficient outcome even if more of the financially troubled airlines exit the industry.

The role of Chapter 11 of the bankruptcy law has proven to be important. The purpose of Chapter 11 is to allow for a reasonable rehabilitation of a going concern instead of a liquidation. Chapter 11 offers guidelines and time frames for reorganization. Courts should be discouraged from repeatedly waiving guidelines for meeting reorganization goals in the airline industry, and their effort to save competitors may be misplaced. In the case of Eastern, for example, the judge extended reorganization from the intended 120 days to two or more years, during which period the company dissipated the full value of its assets. Pan Am's exit from the market was preceded by a lengthy period of operating losses, but much of the liquidation process took place prior to the declaration of bankruptcy, through asset sales. Some of Trans World and Continental Chapter 11 filings have been lengthy. Recent research has suggested that the ticket prices of bankrupt airlines typically decline before the filing for bankruptcy protection and remain somewhat depressed. However, Borenstein and Rose [1995] have found no evidence that the competitors of the bankrupt airline lower their prices or that they lose passengers to their bankrupt rival. Thus, their results indicate that bankrupt carriers have not harmed the financial health of the remaining national competitors.

The Transition toward a More Global Industry

The consolidation movement is taking place internationally as well as domestically, and for many of the same network-based reasons. American, United, and Delta, the three biggest U.S. carriers, which have purchased the former international routes of Pan Am and Trans World, have become international powerhouses. Smaller U.S. carriers, such as Northwest, USAir, and Continental, are also aligning with foreign airlines to provide a similar global capacity.

Global consolidation is also affected by public policy. U.S. laws prohibit full mergers between a U.S. and a foreign airline, a restriction that remains from the days of regulation, and requires a greater degree of government involvement than is the case for other industries. Thus, even if a merger would be approved under U.S. antitrust guidelines, the carriers must nevertheless seek immunity from U.S. antitrust laws. To make the grant of such immunity more palatable in the KLM-Northwest case, the Netherlands recently signed an open-skies trade agreement with the U.S., setting a new standard for U.S.-European freedom of access. In contrast, the opposition to the USAir and British Air alliance was based in part on current restrictions on access to

Great Britain. It is significant that the senior partners in these international consolidations are European carriers. Under European Economic Community Rules, purchase of a European by a U.S. airline would mean that the European airline would lose its status as a community airline and thus its access to the internal European markets.

In terms of our theory, the cooperation associated with international airline alliances is preferred to the restrictions often favored by governments. The largest welfare improvement to consumers will come about through market forces that reduce the number of international players, rather than through governmental interventions aimed at divisions of the pie among existing players.

CONCLUSIONS

We have presented a model of the airline industry in which carriers enhance consumers' willingness to pay by expanding their hub-and-spoke networks. The argument has demonstrated that for reasonable parameter estimates of the level of such endogenously determined investments and other demand-related attributes of the market for airline travel, the equilibrium number of firms in the airline industry will be far fewer than existed during the era of regulation. Because airlines can satisfy consumers' demands for improved flight frequency better, the transition to a smaller number of firms has been welfare-improving. Basically, consumers are willing to pay more to have fewer firms in order to enjoy certain welfare-enhancing service improvements.

We thus arrive at a conclusion that is quite counter intuitive, given normal economic thinking, which focuses only on price. In that world, smaller numbers of competitors mean higher prices and more monopolistic rents. But in a world in which consumers value both price and service, there can be higher welfare with few, rather than with many, national carriers. In sum, the trend of airline consolidation appears to be one which is efficiency-improving. Governmental policies aimed at preserving competitors should be broadened so that market structure consolidations that might benefit consumers can be permitted, both domestically and internationally.

NOTES

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1. It should be noted that not everyone predicted that deregulation would result in an industry with a large number of firms. Robert Frank, who was chief economist at the Civil Aeronautics Board in the early deregulatory years, wrote a detailed memo to the Board (on which Kahn and one of the authors, Bailey, served) in 1980 entitled, "Economies of Scale and Board Policy Toward Mergers", in which he predicted a shakeout of the sort that has occurred in the years since.
2. According to Winston [1993] a net gain of 7.5 billions of 1990 dollars in consumer welfare can be attributed to these improved service benefits, versus a net gain of 3.3 billion in price benefits. Other earlier studies of network economies are Bailey, Graham, and Kaplan [1985]; Morrison and Winston [1986]; and Brueckner, Dyer and Spiller [1992]. An excellent description of the various dimensions of service competition appears in Levine [1987].

3. Other functional forms can be used as appropriate. Berry [1994] uses discrete-choice, random utility function for his full scale empirical analysis. Such a substitution does not alter the main results as is shown elsewhere by one of the authors, [Liu, 1994].
4. This result holds under very general conditions. Its derivation is available upon request from the authors.
5. These results are consistent with those obtained by Grossman and Shapiro [1984] in an information advertising context.
6. See Liu [1994] for a graphical analysis.
7. Their c is our γ, and their b^I is our β.
8. As noted earlier, when $\gamma/\beta = 0.5$, the number of airlines, n, obtained from equation (9) is equal to the equilibrium number of firms in a Cournot competition with free entry.
9. It should be mentioned, however, that Southwest remains a conspicuous exception to this pattern. One of Southwest's main advantages is its significantly lower labor costs. Also, it provides a specialized service that not everyone wants (no interline baggage transfer, no travel agents, etc.). Other small carriers have imitated Southwest. They continue to appear on the fringes of the market, and play a role in stimulating cost-reducing innovation by the national airlines.

REFERENCES

Bailey, E. Contestability and the Design of Regulatory and Antitrust Policy. *American Economic Review*, May 1981, 178-83.

Bailey, E. and Baumol, W. Deregulation and the Theory of Contestable Markets. *Yale Journal on Regulation*, 1984, 111-37.

Bailey, E., Graham, D., Kaplan, D. *Deregulating the Airlines*. Cambridge: MIT Press, 1985.

Bailey, E. and Panzar, J. The Contestability of Airline Markets During the Transition to Deregulation. *Law and Contemporary Problems*, Winter 1981, 125-45.

Bailey, E. and Williams, J. Sources of Economic Rent in the Deregulated Airline Industry. *Journal of Law and Economics*, April 1988, 173-202.

Baumol, W., Panzar, J., and Willig, R. *Contestable Markets and the Theory of Industry Structure*. New York:Harcourt Brace Jovanovich, Inc. 1982.

Berry, S. Airport Presence as Product Differentiation. *American Economic Review*, May 1990, 394-9.

__________. Estimation of a Model of Entry in the Airline Industry. *Econometrica*, July 1992, 889-917.

__________. Estimating Discrete-Choice Models of Product Differentiation. *RAND Journal of Economics*, Summer 1994, 242-62.

Borenstein, S. Hubs and High Fares: Airport Dominance and Market Power in the U.S. Airline Industry. *RAND Journal of Economics*, Autumn 1989, 344-65.

__________. The Dominant-firm Advantage in Multiproduct Industries: Evidence from the U.S. Airlines. *Quarterly Journal of Economics*, July 1991, 1237-66.

__________. The Evolution of U.S. Airline Competition. *Journal of Economic Perspectives*, Summer 1992, 45-73.

Borenstein, S. and Rose, N. Do Airlines in Chapter 11 Harm Their Rivals?: Bankruptcy and Pricing Behavior in U.S. Airline Markets. NBER Working Paper, February 1995.

Bresnahan, T. Sutton's Sunk Costs and Market Structure: Price Competition, Advertising, and the Evolution of Concentration. *RAND Journal of Economics*, Spring 1992, 137-52.

Brueckner, J., Dyer, N., and Spiller, P. Fare Determination in Airline Hub & Spoke Networks. *RAND Journal of Economics*, Autumn 1992, 309-33.

Call, G. and Keeler, T. Airline Deregulation, Fares, and Market Behavior: Some Empirical Evidence. *Analytical Studies in Transportation Economics*, edited by A. Daughety, Oxford: Cambridge University Press, 1988.

Carlton, D., Landes, W. and Posner, R. Benefits and Costs of Airline Mergers: a Case Study. *Bell Journal of Economics*, Spring 1980, 65-83.

Caves, W., Christensen, L. and Tretheway, M. Economies of Density vs. Economies of Scale: Why Trunk and Local Airline Costs Differ. *RAND Journal of Economics*, Winter 1984, 471-89.

Daughety, A. Cournot Oligopoly. *Analytical Studies in Transportation Economics*, edited by A. Daughety, Oxford: Cambridge University Press, 1988.

Dorman, G. Airline Competition: A Theoretical and Empirical Analysis. dissertation, University of California, Berkeley, 1976.

Douglas, G. and Miller, J. *Economic Regulation of Domestic Air Transport: Theory and Policy*. Washington, DC: Brookings Institution, 1974.

Gabszewicz, J., Shaked, A., Sutton, J. and Thisse, J. Price Competition among Differentiated Products: A Detailed Study of a Nash Equilibrium. ICERD working paper No.37, London School of Economics, 1981.

General Accounting Office. *Airline Competition, Industry Operating, and Marketing Practices Limit Market Entry*. Washington, DC: GAO/RCED-90-147, August 29, 1990.

Grossman, G. and Shapiro, C., Informative Advertising with Differentiated Products. *Review of Economic Studies,* January 1984, 63-81.

Hendricks, K., Piccione, M. and Tan, G. The Economics of Hubs: The Case of Monopoly. *Review of Economic Studies,* 1995, 83-99.

Kahn, A. Surprises of Airline Deregulation. *American Economic Review,* May 1988, 316-22.

Kumbhakar, S. A Reexamination of Returns to Scale, Density and Technical Progress in U.S. Airlines. *Southern Economic Journal,* October 1990, 428-42.

Levine, M. Airline Competition in Deregulated Markets: Theory, Firm Strategy, and Public Policy. *Yale Journal on Regulation*, Spring 1987, 393-494.

Liu, D. Service Quality and Industry Structure: Concentration in the LTL Motor Carrier Industry. *Journal of Transport Economics and Policy,* September 1993, 305-16.

__________. Deregulation of U.S. Airlines and Motor Carriers: A Model of Industry Equilibrium and Consumer Welfare. *Research in Transportation Economics,* 1994, 37-65.

Moore, T. U.S. Airline Deregulation: Its Effects on Passengers, Capital, and Labor. *Journal of Law and Economics,* April 1986, 1-28.

Morrison, S. and Winston, C. *The Economic Effects of Airline Deregulation*. Washington, DC: Brookings Institution, 1986.

__________. Empirical Implications and Tests of the Contestability Hypothesis. *Journal of Law and Economics,* April 1987, 53-66.

Oum, T., Waters, W. and Yong, J-S. Concepts of Price Elasticities of Transport Demand and Recent Empirical Estimates: An Interpretative Survey. *Journal of Transport Economics and Policy,* May 1992, 139-54.

Panzar, J. Equilibrium and Welfare in the Unregulated Airline Markets. *American Economic Review,* May 1979, 92-5.

Reiss, P. and Spiller, P. Competition and Entry in Small Airline Markets. *Journal of Law and Economics,* October 1989, S179-S202.

Shaked, A. and Sutton, J. Natural Oligopolies. *Econometrica,* September 1983, 1469-83.

__________. Product Differentiation and Industrial Structure. *Journal of Industrial Economics,* December 1987, 131-46.

Suarez, F. and Utterback, J. Dominant Designs and the Survival of Firms. *Strategic Management Journal*, 1995, 415-30.

Sutton, J. *Sunk Costs and Market Structure: Price Competition, Advertising, and the Evolution of Concentration.* Cambridge: MIT Press, 1991.

Winston, C. Economic Deregulation: Days of Reckoning for Microeconomists. *Journal of Economic Literature,* September 1993, 1263-89.