AIRLINE DEMAND FUNCTIONS IN THE NORTH ATLANTIC AND THEIR PRICING IMPLICATIONS

By Mahlon R. Straszheim*

I. INTRODUCTION

Through econometric analysis of market demand functions, estimates of price and service elasticities can be obtained which are useful in evaluating the consequences of alternative pricing policies. Two pricing questions continually confront the airline industry. The first is the size of fare increases needed to offset increases in fuel and other costs. Persistent operating losses have imposed increasing financial pressures on U.S. carriers, and have necessitated higher subsidies for many foreign flag carriers. The recommended policy is generally to increase fares. Since higher fares will reduce demand, capacity must be reduced correspondingly, or excess capacity will lead to operating losses. The international airline industry has in the past been extremely reluctant to reduce capacity. The magnitude of demand elasticities and capacity adjustments becomes important in assessing the outcome of fare changes; high demand elasticities call for large reductions in capacity.

The second issue is the structure of fares, both the types of service available and the fare for each. The current fare structure is a complex value-of-service pricing scheme which has evolved through a series of politically-motivated compromises between various carriers and regulatory authorities, and with the approval of governments. Through price discrimination scheduled airlines hope to increase revenue and capacity. Economists have generally been quite critical of price discrimination, as will be made clear below.

In the abstract, in deciding whether price discrimination is appropriate and practicable, the critical issue is the ability to distinguish different classes of buyers with different demand functions, or price elasticities of demand; those whose demand functions are least price elastic will be charged higher prices. From the point of view of the scheduled carriers, there are two questions in assessing the current fare structure. One is whether existing restrictions on discount fares confine business travellers to regular scheduled service. The second is whether offering lower fares, or less restrictions on service, will gain more in competition with charter operators than is lost by diversion of traffic from regular scheduled service. Competition from charter operators has forced IATA to offer special services at high discounts from regular fares; by imposing group size, minimum stay, and advance purchase restrictions the airlines have hoped to exclude business travellers from the discount market.

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Because objectives of governments, carriers, and the travelling public vary widely, no consensus on pricing objectives or policies is ever likely. Knowledge of airline demand functions provides useful information, regardless of one's pricing objectives. This paper deals mainly with the statistical estimation of demand functions, with special attention to the income and price elasticities for various classes of service. The hypotheses to be examined involve the role of prices in the growth of the market, and the consequences of introducing special services at discount rates. Section II discusses specification and data problems, and resultant estimates are presented in Section III. The analysis uses data from the North Atlantic, the only market in which data exist disaggregated by type of service. Pricing policies as they relate to market structure are discussed in the final section.

II. DEMAND EQUATION SPECIFICATION AND DATA SOURCES
Most empirical research on airline demand has used cross-section data, usually a sample of city-pair data [1], [2], [6]. This offers the advantage of larger sample sizes than are obtainable in time series analysis. The disadvantage is that there is relatively little variation in a given sample in fares or travel times independent of the stage length of the trip. Airline rate regulation is such that rates per mile among city-pairs vary very little, except for the effect of distance. Nor do travel times for trips of a given length vary significantly. While it can be shown that airline travel as a share of total travel increases with stage length, it is generally difficult to make reliable estimates from such data of fare, schedule or service elasticities. Schedule convenience or flight frequency is jointly determined with demand (i.e., carriers anticipate demand levels in deciding how much capacity to offer). It is not possible to determine the separate effects of schedule frequency by including it as an independent variable in a regression equation of demand, because passenger volume and capacity are both endogenous variables. (Since capacity is endogenous, a supply function explaining capacity must be specified; if such a specification were made, supply variables could be used as instrumental variables to estimate the parameters of the demand equation.) Because of these statistical problems, cross-section analysis has generally been inconclusive.¹

Time series data are more useful in estimating price and income elasticities, since price and income changes in the post-war period have been dramatic. The principal problem with time series analysis is that sample sizes are often too small to permit estimation of the separate effects of all the price and service changes which have affected the market. Several methodological issues and data problems in implementation of time series estimation are outlined below.²

The first problem arises from the absence of origin-destination data. City-pair traffic flow data are not identical with origin-destination data, because many passengers use connecting services. This complicates the interpretation of analysis from city-pair flow data. Passenger travel between two points not receiving direct

¹These estimation problems are reviewed in Mahlon Straszheim and John Meyer [11], ch.8.
²The author has outlined this approach in an earlier study [10]. A recent study using time series data is by John Mutti and Yoshitaka Murai [9].
service is included in flow data for other city-pairs. As schedules and routes change, people may use different connecting cities to make the trip. It is therefore impossible to reconstruct origin-destination data for cities which do not receive direct service. Only a few city-pairs in the North Atlantic have enjoyed direct service for a sufficiently long period to provide a sample large enough for statistical estimation. Reported traffic in these most heavily travelled city-pairs, so-called "gateways," is influenced by the introduction of non-stop service to new points; as new city pairs are introduced traffic is diverted from former gateway points of entry. These diversions significantly contaminate the time series data for the gateway city-pairs.

In contrast, data aggregated for all North Atlantic markets is relatively little affected by diversions (since passengers using various entry and exit points are all included in the data). These aggregate data are used in the estimation below.

The demand for air travel is a "derived demand," and is determined both by air fares and by prices of other goods consumed in travel. Samples are too small to determine the effects of on-shore expenses, which tend to be rather trend-dominated. Other trend-dominated phenomena include people's willingness to travel, or awareness of international tourism as an option, and the loss of fear of air travel. The analysis below has therefore focused only on airline prices, types of service, and income as determinants of airline demand.

Since there are several classes of air travel, each having distinct demand functions, it is inappropriate to talk about "the" price elasticity of demand, as if a unique measure existed. The several classes of air service are substitutes. Travellers will choose between cheaper and more expensive service according to the nature of the restrictions on eligibility for each fare class. For those travellers whose travel plans are least flexible, or who cannot make commitments for long time stays, fixed itineraries, or travel in groups, regular scheduled service will be preferred. However, for many travellers price differentials between the various classes of service will be very important in their choices. A demand function for travel in a certain class \( i \) might be hypothesised of the general form:

\[
z_i = f(P_i, P_j, x_f, \ldots x_m)
\]

where \( z_i \) is the number of passengers in service class \( i \), \( P_i \) are prices of particular types of services, and \( x_f, \ldots x_m \) denote particular restrictions on eligibility for different types of service. If alternative services are substitute commodities, the cross elasticity of demand should be positive; \( \frac{ds_i}{dp_j} > 0 \), where \( P_i \) denotes the price of service \( j \). Income elasticities should be positive, and direct price elasticities negative.

While in theory prices and service restrictions on all classes of service should be included in the demand equations for each type of service, there is insufficient information with the sample sizes available to estimate all the cross elasticities and the effects of eligibility restrictions on various types of services. Only a few price variables can be included in the demand equations.

Much of the demand data is an aggregation of several types of air service. Such aggregation can create problems in interpretation of results. Several examples will illustrate the specification problems which arise. Assume the market is comprised of two submarkets, with travellers choosing between regular and discount fare ser-
vice, the latter a service with some type of restriction such as length of stay. Assume price elasticities are zero and that prices are set higher in one market. If the lower price market is growing at a faster rate, average realised revenues per passenger will decline. A regression of demand on "price", defined as average realised fares, would erroneously conclude that there is a non-zero price elasticity. Another illustration is the case in which an across-the-board fare change is made. If the fare change results in travellers shifting from one type of service to another, a weighted average of realised fares may be greater or less than the ex-ante fare change. The resultant estimate of the price elasticity of demand will depend on how price is defined in the equation, particularly on whether ex-ante prices or realised average revenues are used as the measure of price.

The example of changing eligibility rules reveals a different type of specification problem. Suppose there are two classes of service: regular service at a higher fare, and a cheaper excursion service. Suppose further that in a given year the length of stay or some other restriction on who qualifies for the excursion service is relaxed. As a result, some passengers switch from regular to excursion service. Revenue (fares weighted by the number of passengers in each class) will decline. Assume further that total traffic increased during the year, in response to the lower restrictions on eligibility for discount service. A regression of passenger demand on "price", defined as a weighted average of realised fares, would reveal a non-zero price elasticity. However, whether the growth in demand would be increased by reducing fares on one or both types of service but keeping the restrictions on eligibility unchanged cannot be determined from such a regression. In the North Atlantic changes in fares and eligibility restrictions for various classes of service have often occurred simultaneously, complicating the determination of the separate effects of each.

The approach to these specification problems is to use disaggregated data whenever they exist for particular types of service. Ex-ante fares, rather than realised revenue per seat, are used as the measure of prices.

Data on First Class and Economy traffic are available for the entire post-war period. Since 1963 data for Economy service has been further divided into three classes, depending on the size of the fare discount: Standard Economy service, Excursion service (mostly 14-28 day excursions), and High Discount service (excursions longer than 28 days and group travel) [7], [8].

Price variables are based on agreed IATA tariffs for round-trip service, New York-London. There has been relatively little variation in the structure of fares among city-pairs in the North Atlantic over the post-war period. Because of the importance of attracting tourists no country is willing to risk its market share by charging higher fares in its gateway, independent of the stage length, than are charged by any other country. An index of fares based on an average of all city-pairs would be almost perfectly correlated statistically with New York-London or any other major city-pair fare over the historical period. The tariff for the year used in the regressions was that put into effect in April, which is generally the month of fare changes. Seasonal fares were averaged, using a constant set of weights based on a representative seasonal traffic pattern. Several different fares or fare indices were used as price variables in the regressions below in an attempt to measure cross-elasticity relationships. Certain promotional and discount fares were averaged, in
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an attempt to define price indices relevant to the several classes of service being examined. The following price and income variables were used:

\[
\begin{align*}
PF & = \text{First Class fare} \\
PY & = \text{Economy fare (average of peak and off-peak)} \\
PPY & = \text{Peak Period Economy fare} \\
PEX & = \text{Excursion fare (average of excursion rates of all durations)} \\
PDIS & = \text{Highest Discount non-group rate (excursion fares 14-28 days, 1963-68; 29-45 day excursion rates, 1969-73)} \\
Y & = \text{Gross National Product, United States.}
\end{align*}
\]

All variables were expressed in real terms by deflating by the U.S. consumer price index. Since the United States and European economies are closely linked, little would be gained by defining a weighted average of incomes of countries in Europe and the United States. (The sample is too short to test alternative hypotheses regarding specification of the income term.) Various other price indices not presented above were also tried. Because of the short time series used, many of the price series proved highly correlated. The specification of the price variables in the analysis below proved to be the best fit of the sample data.

In many cases it is implausible to assume that eligibility requirements for the various types of travel enter demand equations as continuous variables. The procedure followed below is to introduce dummy variables in those years in which the most important structural changes in classes of service were introduced, as a means of separating these effects from pure price effects. This is an admittedly crude procedure, but with very short time series it is not possible to introduce very many dummy variables or other ad hoc representations of changes in service into the equation. The exact manner in which dummy variables are used will be explained below in discussing the results.

Logarithmic equations proved to be a better fit than linear equations. As in many cases of demand estimation with time series data, autocorrelation in the error term was evident. It was assumed that the error term could be characterised by a first-order Markov process. The autocorrelation coefficient was estimated jointly with the demand coefficients, using the Cochrane-Orcutt method. This nonlinear procedure normally converged. In some of the equations the first order autocorrelation coefficient proved statistically significant.

III. ESTIMATION RESULTS

First Class Travel

It has generally been hypothesised that first class demand is price inelastic, and little affected by the types of economy service available or by economy fares. A demand equation for first class travel was estimated for two periods, 1948-1973 and 1952-1973, the latter being the period in which both economy and first class travel were available. Results appear in Table 1. In the regression for the entire post-war period, the introduction of tourist service is represented by including a dummy variable denoting the period from 1952 to the present. This dummy variable captures the one-time shift to tourist service. The estimate has a modest level of
### TABLE 1

**Demand for First Class and Economy Travel, North Atlantic**

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent Variable</strong></td>
<td><strong>Estimated Coefficient</strong></td>
<td><strong>Estimated Coefficient</strong></td>
<td><strong>Estimated Coefficient</strong></td>
</tr>
<tr>
<td>Constant</td>
<td>C</td>
<td>6.123</td>
<td>5.831</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(35.62)</td>
<td>(91.32)</td>
</tr>
<tr>
<td>First Class Fare</td>
<td>PF</td>
<td>-0.755</td>
<td>-0.649</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.21)</td>
<td>(7.78)</td>
</tr>
<tr>
<td>Dummy Variable: Introduction of Tourist Service</td>
<td>DT</td>
<td>-0.276</td>
<td>N.A.</td>
</tr>
<tr>
<td>Income</td>
<td>Y(-1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.96)</td>
<td>N.A.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.52)</td>
<td></td>
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<tr>
<td>Economy Fare</td>
<td>PY</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Peak Economy</td>
<td>PPY</td>
<td>-</td>
<td>-</td>
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<td></td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>First-Order Autoregressive Coefficient</strong></td>
<td>( \rho )</td>
<td>0.759</td>
<td>0.588</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5.57)</td>
<td>(5.20)</td>
</tr>
<tr>
<td>R^2</td>
<td></td>
<td>0.543</td>
<td>0.770</td>
</tr>
<tr>
<td>D.W.</td>
<td></td>
<td>1.810</td>
<td>1.776</td>
</tr>
<tr>
<td>S.E.E.</td>
<td></td>
<td>0.116</td>
<td>0.149</td>
</tr>
</tbody>
</table>

* t-ratio in parentheses
** Economy travel includes both tourist and economy service
N.A. — not applicable for this sample

The direct price elasticity of first class travel is estimated to be -0.76, and the cross elasticity with economy fares was insignificant. Inclusion of income in the equation was unsuccessful; the coefficient has the wrong sign, so it has been dropped from the equation. The estimated price elasticities are well above what most people would expect on a priori grounds. For the more recent period, 1952-75, the estimate of the direct price elasticity is -0.65, and the cross elasticity has the wrong sign.

The probable explanation for this decline in price elasticities over time is the widening fare differential between first class and economy service in the 1950s, and the gradual division of the market into a very small first class portion and a much larger economy portion. Over the period of the 1950s the share of the market using first class shrunk, and the first class travel market evolved into its present form—a small group of business and government travellers, whose travel demands are apparently insensitive to price.
Economy Travel, 1952-73

The overall Economy market is, as noted, an aggregation of many submarkets. The market for Economy service is highly price elastic. In the analysis below a number of price indices were employed, including both prices for particular types of service and price indices defined as weighted averages of several fares. Because of the short time period, it was not possible to include any of the many restrictions on eligibility in the equation.

The estimated equation includes income lagged one period, the average of economy fares for peak and off-peak periods, and the peak period economy fare. The summer travel season is dominated by tourists, occasional travellers, and many young travellers, all of whom are probably more sensitive to price. In order to conduct a simple test to show whether this change in composition affects the overall price elasticity in the market, both peak and off-peak season prices were included in the equation. Because the airlines have priced the peak and off-peak periods quite differently over the sample period, these two price series are not too highly correlated to be included together.

The results appear in Table 1. The estimated price elasticities are well above unity, suggesting that travellers are quite responsive to lower fares. Peak period prices have the larger elasticity (−1.92), reflecting the predominance of price-sensitive tourists in the summer months. The high peak period price elasticity clearly indicates that the proper pricing strategy for the airlines from a revenue-maximising point of view is to offer summer discount prices.

Attempts to estimate a cross elasticity of demand between economy and first class travel by including first class fares in the equation were unsuccessful, a result consistent with the earlier discussion indicating that the cross elasticity between these two markets is zero or very low.

The income effect was represented by lagging income one period. Experiments with no lag on the income variable or with a two-year weighted average were not successful. While the evidence suggests that economy passengers respond to income changes with a lag, the time series is too short to permit complete tests of the lag structure.

The estimated price elasticities are above those obtained by Mutti and Murai [9], using more recent data, 1964-74. Their methodology differed in two respects: price was defined as an average of realised fares rather than by an index of ex-ante fares, and ordinary least squares estimation was employed. Their reported Durbin-Watson statistics suggest that autocorrelation in the error term may be a problem; hence their reported standard errors on coefficients are understated. Nevertheless, their much higher estimates of income elasticities and lower price elasticities contrast with the results reported here.

Economy Travel since 1963

The results above indicate that the price elasticity of the "overall" economy market is greater than one. The difficult questions confronting the airlines and public policy makers involve the segmenting of the economy market into types of travellers. From examination of historical data it is evident that a large tourist market exists which is responsive to lower priced air service, even when many restrictions in terms of length of stay, group requirements, or other restrictions are
imposed. Promotional traffic has greatly increased its share of total traffic (see Figure 1). Examination of the monthly seasonal pattern for each type of fare reveals that excursion, group inclusive tour, and youth fares have dramatic seasonal peaks, suggesting that tourist travel predominates in these classes (see Figure 2). The North Atlantic is increasingly becoming stratified into two markets: a tourist market concentrated in the summer season, highly responsive to price, and a second, much smaller, market exhibiting very little seasonal variation, which uses standard economy and first class fares. It is also evident that there is a significant cross elasticity between the various classes of air service. Special restrictions or discounts for one class of traffic often result in switching to or from other types of service.

The analysis below focuses on three types of service for which data are available: Standard Economy, Promotional (excursion 14/17-21/28 days), and High Discount (excursion 29-45 days, group inclusive tour, contract bulk inclusive tour, affinity, and incentive group fares). The High Discount market is the lowest price segment, with restrictions on size of group or longest length of stay. A critical question facing the airlines is what amount of diversion from standard economy service will result if additional discount-type service is made available. The cross elasticities among the many types of service are therefore of special interest. The analysis below reveals these submarkets to have different demand functions.

In the analysis of Standard Economy service (no restrictions on length of stay or advanced purchase), the cross elasticities between First Class fares and demand, and between 14-21 day excursion fares and demand, are most important. The 14-21 day excursion is the least restrictive type of service with lower fares, and hence is the most likely substitute form of air travel for those contemplating Standard Economy service. The estimated demand function for Standard Economy service, 1963-73, appears in Table 2. No income effect appears. The direct price elasticity for peak period fares is about unity. This substantially smaller elasticity for that portion of the total economy market which does not use special types of service at discount prices is to be expected.

The dummy variable for the post-1970 period is significant, reflecting the shift from Standard Economy service toward the high discount fares after 1970. An additive dummy variable to this logarithmic equation provided the best fit, implying that the diversion resulting from the new service introduced in 1970 is declining over time; this is as expected, given the huge decline in Standard Economy travel by 1973. Attempts to measure the cross elasticity of demand between Standard fares and Discount fares by including the Discount fare in the demand equation for Standard Economy service were unsuccessful. The only form which yielded the proper sign, though at a low level of statistical significance, was the ratio of standard economy fares to fares on 22-45 day excursions. The estimated elasticity was about 0.20. The post-1970 dummy variable provides a crude measure of this cross elasticity effect.

The equation for High Discount travel includes income, price, and a dummy

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3 Because of high correlation between peak period and off-peak period prices over this period, it is not possible to include both in the equation. Virtually identical results are obtained when the off-peak fare is used as the price variable.
variable for the post-1970 period. (See Table 2.) The estimated demand function for High Discount travel has a very high price elasticity, $-2.73$. The post-1970 dummy probably captures the effect of the introduction of 29-45 day excursion service, which led to dramatic growth in this portion of the market. That the dummy is significant in addition to the price term suggests that the price index for discount fares is not capturing all the effects of changes in price and service restrictions after 1970. The 29-45 day excursion rates were introduced in 1970, and rules on other high discount group rates were liberalised.

Similar statistical results describe the equation for the combination of High Discount and Promotional fares. (See Table 2). Again, a weighted average of excursion fares as a price proxy exhibited a price elasticity of $-1.81$, and the post-1970 dummy variable reveals the growth traceable to the 1970 introduction of high discount fares. This combined market appears less price sensitive than the High Discount market, as theory would suggest. Attempts to include Standard Economy fares to test for a cross elasticity resulted in coefficients with the improper sign.\(^4\)

\(^4\) The cross elasticity between High Discount and Promotional fares is probably high, the share of the market using 14-21 day excursion fares having fallen sharply since 1971. The data are insufficient to allow statistical analysis of the magnitude of this cross elasticity.
Figure 1
COMPOSITION OF NORTH ATLANTIC SCHEDULED TRAFFIC, 1963-1973
DEVELOPMENT OF LOW FARE TRAFFIC

(1) FIRST CLASS AND ECONOMY NORMAL
(2) ECONOMY EXCURSION 14/17-21/28 DAYS AND "ALL OTHER" PROMOTIONAL FARES
(3) EXCURSION 29-45 DAYS, GROUP INCLUSIVE TOUR, CONTRACT BULK INCLUSIVE TOUR, AFFINITY AND INCENTIVE GROUP FARES

Source: International Air Transport Association [7].
MONTHLY DISTRIBUTION OF SCHEDULED PASSENGERS
BY FARE CATEGORY—1973

Source: as for figure 1.
Because of the short time series available, the results do not provide conclusive evidence on all the direct and cross-price elasticities of interest. It is evident that there is some cross elasticity between Standard Economy and Discount services, since discount traffic jumped dramatically in 1970 at the expense of regular service. However, these cross elasticity effects are probably diminishing over time. By 1973 promotional fares accounted for 75% of the North Atlantic market and were growing rapidly. This more recent growth is not from Standard Economy market, but rather from diversion from charters. Mutti and Murai [9] have shown that significant cross elasticities exist between these markets.

IV. MARKET STRUCTURE AND PRICING POLICIES: IMPLICATIONS

Translating demand analysis into pricing policies requires formulation of basic policy objectives, and involves analysis of many of the important components of market structure. As noted, there is disagreement both on the objectives of fare policy and on the consequences of alternative policies.

The pricing objective typically recommended by economists is that of economic efficiency, which requires that fares for different types of service be related to the costs of providing the service by least-cost or efficiently managed carriers. To specify an economically rational air fare structure requires analysis of the nature of costs involved in various classes of scheduled and charter services.

Perhaps the most important considerations in determining optimal fares involve the relationship between capacity, fares, and load factors. A tradeoff exists between fares and capacity [12]. Greater capacity or lower load factors implies higher schedule frequency and convenience, and a high probability that a seat is available at the desired departure hour. However, more capacity can be financed only by higher net revenue, therefore to determine the optimal price level it is necessary to specify schedule frequency. Travellers will differ in their preferences in this regard: business travellers will prefer lower load factors, while tourist travellers will probably prefer lower fares at the expense of less schedule frequency. Airline labour and management are likely to have a strong preference for a pricing policy which minimises load factors, since this objective maximises capacity or firm size measured by the size of the fleets. Many governments have the same objective for their flag carriers.

Many fare objectives other than marginal cost pricing have also been suggested: subsidising travellers, attracting more tourist travel to particular ports, etc. Some countries may want prices set above the cost of efficiently managed carriers so that their own less efficient flag carriers can operate without subsidy. In debate in the United States on objectives with respect to fares, many diverse objectives have been suggested by advocates of particular policies on air fares: for example, conserving jet fuel, stimulating more travel abroad (or to the United States), selling more U.S.-built aircraft, increasing airline revenues, and stabilising or altering airline market shares. Seemingly every carrier and every country has been interested in some form of price discrimination.

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The political debate over objectives is not likely to be resolved soon. Perhaps the most serious economic issue in analysing pricing policy is the concern that elements of market structure preclude a competitive or quasi-competitive market regime with prices related to cost as described above. According to this point of view, the industry is characterised by high fixed costs and decreasing marginal costs; therefore marginal cost pricing implies losses. Also, it has been argued that carriers’ individual incentives preclude them from reducing capacity in the face of falling demand, so that the industry is doomed to continued excess capacity and below-normal rates of return on capital. Elaborate entry controls, capacity limitation or pooling agreements, and pricing discrimination are the recommended solutions. Mutti and Murai have recently endorsed capacity controls and price discrimination on this basis [9].

It must be noted that price discrimination as a means of increasing revenues to finance additional capacity has a long history in transport and public utility regulation. Cross-subsidy of some markets, by charging prices above costs in other markets with less elastic demands and limiting outside entry by regulatory protection, is often endorsed. Such divergence from marginal cost pricing almost certainly is a move away from a Pareto-efficient outcome. If a particular activity is characterised by declining marginal costs, the efficient solution requires lump sum tax redistribution to offset operating losses. Whether one approves of price discrimination therefore almost inevitably depends on one’s judgement about the merits of the particular income redistribution being achieved.

Whether market structure implies operating losses and hence the need for subsidy (for example, direct subsidy or price discrimination) is a more complex issue. Carriers’ costs reflect type of aircraft, route system, and scheduling efficiency. While there is some variation in costs attributable to stage length, route density, and management, all the available statistical evidence on airline costs reveals no scale economies independent of these route system effects [3], [4], [5], [11]. Realised profits will reflect both costs and the fare structures. A number of smaller carriers have earned profit rates comparable to or exceeding the industry average. Since the fare structure may in fact overprice long haul, dense routes served by the large carriers, the profit performance of smaller carriers suggests that they do not suffer from scale diseconomies.

Mutti and Murai’s suggestion that airlines have high fixed costs, with examples assuming that only one third of costs are variable, appears to mix up short and long run cost considerations. An increasing share of airline costs becomes variable as the planning horizon is extended. Airlines make up their schedules six months to a year in advance. Equipment can be ordered for delivery in about two years, and excess equipment can be leased and orders cancelled.

The evidence also indicates that airlines can adjust capacity up or down. While downward adjustments in output can impose hardships on airline employees who are laid off, as they do in any industry, the ability of U.S. carriers to make such adjustments should not be minimised. Pan American reduced its personnel by almost one third (59,386 on 31 December 1969, to 26,954 by 15 February 1976) over a six-year period. Faced with mounting fuel costs and declining traffic, Pan Am cut its available seat miles by 10.8% in 1974 and by 2.9% in 1975; revenues increased 4.8% in 1975, while costs rose by 0.1%. Capacity deliveries were cut and service
suspended on many routes. Many of these adjustments occurred before March 1975, when the major Pan Am-TWA route swap agreements were implemented.\textsuperscript{5} TWA made similar downward adjustments in equipment orders, capacity, and personnel [15, p. 224], and so did other U.S. carriers. The carriers were in severe financial straits during this period, partly because of commitments to too much capacity; but the extraordinary fuel price increases and the world-wide recession could not have been anticipated. When financial conditions become bad enough, carriers will reduce capacity.

The possibility that carriers individually have no incentive to reduce capacity because of disproportionate losses in traffic has received much attention. This schedule competition implies that market equilibrium with below-normal profits could result. The facts do not support this concern. Miller's exhaustive study of changes in a carrier's traffic as related to changes in capacity for the U.S. domestic industry revealed the elasticity to be near or slightly below unity.\textsuperscript{6} Mutti and Murai's analysis of shares in the North Atlantic in 1974 reveals the same results [9, p. 52]. If elasticities are below one, carriers may reduce capacity and not lose so much traffic as to be eliminated from the market. In short, the structure of costs and the nature of scheduling competition do not preclude a competitive market outcome. The current evolution in the U.S. domestic industry toward deregulation will put this argument to the test.

The principal problem with the argument that competition will work reasonably well in the international airline industry remains largely a political one: that political considerations dominate decisions on entry and capacity levels. Many countries offer international air service though their carriers are not cost competitive. Capacity is often provided when losses are incurred. Governments are often unwilling to reduce capacity and market share unilaterally, even when all carriers are sustaining sizeable operating losses. The desire to attract tourism is an important part of this attitude. It is the commitment of governments to subsidise their flag carriers that underlies the continual "excess" capacity problem in international air markets [10]. It is difficult to be confident about the prospects for normal profits in this market regime. U.S. carriers enjoy cost advantages, yet this has not been sufficient in recent years to produce normal profits.

The most frequently proposed alternative market structure is a carrier cartel with capacity sharing or pooling agreements. The author has argued elsewhere against this approach [12]. The view that competition will produce better economic performance than a carrier cartel is supported both by theoretical arguments and by empirical evidence on airline markets of the two types. A brief theoretical analysis of the major types of pooling agreements suggests that poor market performance is the likely result. The most limited type of agreement includes only capacity sharing rules in which capacity levels are determined by agreement. Under this system, airlines have incentives to schedule flights to maximise their market shares; the familiar result is that many flights are scheduled at the same time of the

\textsuperscript{5}Statement of William T. Seawell, Chairman, Pan American Airlines in [13], pp. 8-38.

day. Carrier incentives to promote market development are lessened, since additions to capacity to serve a larger market must be shared with other carriers. A revenue pooling agreement in which capacity levels are determined and revenue is shared according to a fixed rule would lead to more variation in scheduled departure hours (pooling revenues eliminates the implicit penalty of lower load factors at off-peak hours). At the same time, carriers would no longer retain incentives to provide high quality service, since revenue is pooled. It is likely that carriers would cut costs at the expense of service quality. The most complete pooling agreement is one in which profits are shared; this much reduces carrier incentives to provide good service or to control costs.

The fundamental problem with pooling agreements, in brief, is that attempts to organise different nations' carriers into a cartel can never completely eliminate the individual interests of participating carriers: the result is counter to the goals of providing good service and stimulating market growth. It is very difficult to devise administrative rules to divide markets which do not reduce carrier incentives to provide cost-efficient, quality service. Moreover, if either side's carriers fare badly under the new rules, there is likely to be pressure for modification in the form of additional governmental restrictions and intervention in the market. Performance over the long run is likely to deteriorate.

In addition to these theoretical arguments favouring competition rather than cartelisation of air markets, a review of performance in major international airline markets run on a pooled basis provides strong evidence favouring competition. As noted, pooled markets ostensibly offer the advantage of less capacity and higher load factors, which would permit lower fares. The experience in European markets is quite the reverse. Pooling agreements have increased load factors, with the associated reduction in schedule convenience; yet, contrary to the theory, fares have been dramatically higher still. Fares are often 25 cents to 30 cents per passenger mile in Europe, about twice the level of fares in the United States for routes of comparable stage lengths. (Higher fuel costs in Europe account for only a tiny fraction of this difference).

A system of intergovernmental negotiation of capacity introduces additional problems. Capacity decisions in one bilateral agreement may influence negotiations and capacity levels approved under like bilateral agreements with other nations. Governments will be involved in negotiations over capacity with many governments each year, and each negotiation will be dependent on capacity levels arrived at in other negotiations. This uncertainty makes carriers' investment and marketing decisions much more difficult. The likely evolution would be toward fixed schedules, and an environment in which it would become increasingly difficult to alter capacity levels. Yet future travel patterns are very difficult to predict, and may be quite different from those of today. In short, while the prospects for profitability are not good with cost-based fares and "competitive" scheduling, the alternatives of government or carrier cartels are much worse. Carrier cartels would over the long run reduce losses at the expense of service to the travelling public.

Fare structure should in the author's view be based on long-run marginal costs. While costs have not been analysed here, this would involve:

1. retaining peak/off-peak pricing;

2. making several changes in scheduled fares to relate fares to route density.
Rates 25% lower in the densest city-pairs would not be out of line with cost differences. In addition, load factors should be significantly higher in high density routes;

(3) eliminating free stopovers;

(4) basing discount fares on advance purchase and/or group size, the two principal characteristics of air travel which allow airlines significant cost savings and the opportunities to achieve higher average load factors;

(5) allowing an advance purchase discount on all tickets, scheduled or charter. To the extent that group discounts reflect cost savings, they should be available to any group. Affinity rules should be abolished. If travel agents or other parties can organise charters, they should be free to market group flights.

Whether cost differentials as a basis for advance purchase discounts are as large as the price discounts now being proposed requires more analysis of costs and realised load factors when such discounts are actually being provided.

This list omits any reference to length of stay or the amounts of money committed to ground activities, hotels, etc, during the stay. There is no relationship between the length of passengers' stay or their ground activities and the costs of providing air service. For example, the cost economies in making air, hotel, and ground transport reservations as a composite commodity rather than allowing travellers to purchase these commodities separately is virtually zero. Quite the reverse; the scheduling inflexibility created by requiring these products to be purchased jointly can be quite substantial. Excursion and inclusive tour rates should therefore be abolished.

The demand estimates in this paper suggest two implications important to the evaluation of alternative pricing policies. First, the statistical evidence suggests that airline demand is relatively price elastic, for all but the five per cent of the market using first class. Thus, if fares are increased substantially to offset higher costs, total demand will decline substantially. The large price elasticities presented in this paper imply that the industry will be confronted with large capacity adjustments. Further pressure to adopt capacity agreements in the industry and/or greater pressure to subsidise flag carriers will surely be forthcoming.

The statistical evidence will also be useful to those who endorse a policy of price discrimination, a fare policy aimed at increasing total revenues. First class fares can be raised and will increase total revenue. With respect to Economy service the results are more complex because of the segmentation of that market. The demand elasticity for standard economy service is above unity, and highest for peak period travel. From a strictly revenue maximising point of view, greater peak-off-peak differentials would be appropriate. The demand for discount and promotional fares is highly price elastic, suggesting that these fares could be lowered still further and total revenue for this portion of the market would be increased. It appears that the demand growth associated with lower fares is attributable to diversion from the charter market. These results therefore suggest that the scheduled airlines could more aggressively compete with charter service on the basis of fares, increasing both traffic and total revenue by lowering peak period discount and promotional fares still further.

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REFERENCES


