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A PROPOSED PRICING PROCEDURE
FOR DOMESTIC AIRLINES

C. K. WALTER*

In this article Professor C. K. Walter develops an alternative procedure for fixing airline fares. The premise of the proposal is that ticket prices should be dependent upon the distance from point of origin to point of destination, regardless of the routing or airlines involved. Professor Walter argues that this proposal is flexible and programable and that it can provide equitable prices and reasonable allocation of revenue among the air carriers.

I. INTRODUCTION

THE PASSENGER airline tariff structure has been the subject of recent criticisms because of the number of incorrect fares, usually overcharges, encountered by customers. Observation and experience indicate other inequities in the fare structure. The Civil Aeronautics Board has recently taken steps to remedy some of the fare problems by ruling certain promotional fares illegal and requesting additional publication of joint fares for trips involving more than one airline. The underlying problems of complexities in the fare structure still remain.

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3 CAB Seeks Data on Joint Fares, 97 AV. WEEK & SPACE TECHNOLOGY, Oct. 9, 1972, at 27.
The purpose of this article is to propose a tariff construction system for domestic airlines that would be equitable to both passengers and airlines, logical in its reasoning, and programable for computation. The marketing concept is introduced to airline pricing, a significant departure from the contemporary norm. Different types of trips involving joint fares, a particular point of criticism in current practice, are described and the proposed system demonstrated. Arguments for and against the proposed system are discussed. While the article specifically is directed at the airline passenger tariffs, the general concept could be applied in other modes and with other cargoes.

II. INDICATIONS OF AIRLINE INDUSTRY PRICING PROBLEMS

A. Promotional Fares

The two main contributing factors to the airline industry's pricing problems are discount or promotional fares and joint fares. The North American edition of the Official Airline Guide contains three pages of “Family Fares;” two pages of “Special Fares” for children, clergy, military, parents and spouses of military personnel, senior citizens, youth and others; and two pages with ninety-nine notes explaining excursion fares. Fourteen possible air fares, ranging from $84 to $210, for a non-stop trip between New York and Los Angeles have been identified.

Irritation over promotional fares has been voiced by businessmen who are annoyed at “having to pay the base price while airline marketing men devise discounts aimed at attracting the pleasure traveler.”

The fare situation is even more complicated for international carriers and more confusing for international travelers because regulating agencies of several countries are involved in rate negotiations. A British publication commented:

The British and American Governments have cheerfully maneu-

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4 How Airlines Overcharge, at 321.
7 Cutting Executive Travel Costs, Business Week, Jan. 15, 1972, at 52.
vered themselves into an impasse over North Atlantic air fares, and this is having a disastrous effect on bookings.9

A publication of the Air Transport Association of America gave less than full support to promotional fares:

Many of these promotions have proved highly attractive to the public and successful for the airlines . . . . However, some of the promotions, less well designed, have served merely to dilute total industry revenues.6

One estimate of the effect of discount fares was that they were reducing revenues by about eight percent per year.10

Other industry spokesmen include H. Don Reynolds, former assistant director general of the International Air Transport Association, who said:

Fare simplification is an appealing catch phrase . . . . But it cannot be achieved unless all promotional fares are thrown away and the airlines return to two basic classes of service. If there is going to be one promotional fare, you will never get two people to agree what that promotional fare ought to be.11

L. B. Maytag, President of National Airlines, called for airlines to return to a pricing structure “based on the one seat/one passenger/one fare concept.”12

Reflecting the changing attitudes of and about the industry, the Civil Aeronautics Board has declared certain promotional fares to be illegal, interpreting the Federal Aviation Act as prohibiting the airlines from “taking social policy into fare-making consideration.”13 The reasoning behind this decision was that the passengers who paid the normal fare have to make up the savings obtained by those traveling on discounted fares. The Board has ruled that youth and family promotional fares must be phased out, beginning

13 See note 2 supra.
June 1, 1973, and cancelled completely one year later. As additional evidence of the position taken by the CAB toward promotional fares, a recent airline proposal for another excursion fare was summarily rejected with the comment that it "may be unjust, unreasonable, unjustly discriminatory, unduly preferential, unduly prejudicial, or otherwise unlawful."

The resultant effect of the reduced number of promotional fares remains to be seen. It is unlikely that significant passenger volume will be lost. According to the ATA:

Generally speaking, however, when fares go up airlines don't lose an appreciable amount of traffic. The reason is that for most people who travel by air the saving in time outweighs the added transportation expense.

B. Interline Fares

Consumers Union of United States, Inc., through its publication, Consumer Reports, has been a leader in criticizing interline pricing policies: "Probably the highest risk of overcharge awaits the traveler to smaller cities on routes involving a change of airlines."

The Consumers Union estimates that five million passengers per year traveling on 27,000 routes were affected. For trips necessitating a change of planes and airlines, the through fare may have been previously agreed upon by the connecting airlines and published as a joint fare. When the connecting lines have not published joint fares it becomes necessary for the ticket agent to construct the fare according to CAB procedures. The magazine reported a brief market experiment as evidence of possible widespread overcharging:

Yet when CU recently purchased 31 one-way coach tickets from 10 airlines for a selection of two-airline routes with unpublished fares, we were overcharged for 20 of those tickets. The overcharges ranged from $2 to $21 and averaged $12.37—about 20 per cent more than the average correct fare. Nobody undercharged us.

This report prompted the CAB to make its own investigation in

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15 American Cut-Rate Fare Barred by CAB; TWA Studies UAL Bid, 98 Av. WEEK & SPACE TECHNOLOGY, April 30, 1973, at 25.
16 See note 9 supra.
17 How Airlines Overcharge, at 321.
18 Id.
which it found a rate of error of fifteen per cent, considerably below the sixty-four percent in the above experiment.\textsuperscript{19} When Consumers Union then audited the CAB's ticket sample and found additional, unreported errors, it concluded:

The inability of the CAB, of all people, to get its fares straight underscores once again the need for a simplified, computerized fare structure that can be understood by the public, the airlines and the CAB.\textsuperscript{20}

In a later CAB Bureau of Enforcement audit of 612 interline tickets, 193 incorrect fares were found, an error rate of thirty-one percent. Overcharges of $1.69 to $51.36 were found in 159 cases, along with thirty-four undercharges from $1 to $12.58.\textsuperscript{21} The CAB has requested that domestic airlines "expand their publication of joint fares to avoid errors in computation."\textsuperscript{22}

C. Fare Construction

The fare construction rules provide that, even if a joint fare is not published, a person traveling from origin A to destination B, with a change of airlines at some intermediate point C will be charged no more than a traveler going to some further point D. This rule is important because the individual fares for A to C and C to B frequently do add to an amount greater than the joint fare from A to D. \textit{Consumer Reports} cited a routing from New York (assume point A) to Dubuque, Iowa (point B), with a change of airlines at Chicago (point C). Although there was not a published joint fare from New York to Dubuque, there was a published fare from New York to Cedar Rapids (point D), the next stop on the route. When the example was published, the sum of the individual point-to-point fares from New York to Chicago plus Chicago to Dubuque was $84, while the New York to Cedar Rapids joint fare was published as $73. Therefore, the correct New York to Dubuque fare would be limited to $73.\textsuperscript{23}

\textsuperscript{19} \textit{CAB Speaks Softly}, at 692.
\textsuperscript{20} \textit{CAB Cites Airlines for Overcharging}, 38 \textit{CONSUMER REPORTS}, June 1973, at 371.
\textsuperscript{22} \textit{CAB Seeks Data on Joint Fares}, 97 Av. Week & Space Technology, Oct. 9, 1972, at 27.
\textsuperscript{23} \textit{How Airlines Overcharge}, at 321.
Although the procedures are not extremely complex, they do require ticketing personnel to consult several reference publications of joint fares, point-to-point fares, routes, and codes—all somewhat tedious and time consuming. It was reported that many agents "had neither the time nor the training," and would commonly "just add the various point-to-point published fares." One agent suggested that "anyone who purchases a ticket that is the least bit complicated runs a big risk of being overcharged."  

D. Solutions

In relation to potential customers, Consumer Reports concluded that there was no "sure-fire way of avoiding overcharge." While better training of ticket agents would appear to be at least a partial solution, agents considered that "the great number of fares, rules and conditions and their frequent changes added up to too much to master." Surveying the entire passenger fare problem, Consumers Union suggested:

(i) Air fares should be simplified and presented in easily understood terms, for the benefit of ticket agents and consumers alike.
(ii) Information about discount rates should be posted in airports and airline ticket offices.
(iii) Each airline should prepare and distribute cards listing fares between any two points it serves.
(iv) For more complicated situations (trips involving more than one airline, for example), ticket agents should have ready access to a computer that can determine the fare promptly and correctly.  

A procedure for computing passenger fares meeting the above requirements is developed in the balance of this article.

III. ASSUMPTIONS BEHIND THE PROPOSED PRICING PROCEDURE

Premise 1.—A customer wishes to travel from some originating airport A, to some destination airport B, and is willing to pay what he considers to be a reasonable amount for this service. In most instances, his A to B travel is only part of a slightly extended

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24 Id. at 322.
26 How Airlines Overcharge, at 324.
27 See note 25 supra.
28 Still Searching for a Correct Air Fare, 38 CONSUMER REPORTS, Feb. 1973, at 84.
journey involving other modes of transportation, such as driving from his home, real origin A' to A, and riding a rapid transit train from B to a business meeting at real destination B'.

While the customer had no hand in determining the placement of airports A and B, he did make the decision that these best fit his particular travel requirements for the intended trip. Commonly, the number of airports with commercial service near points A' and B' will be only one each, so for most real origin and destination pairs, A'-B', the corresponding airport pairs, A-B, have already been determined by the makeup of the surrounding infrastructure. In some large population centers, such as New York, Chicago, and Los Angeles, the number of airport pairs is slightly larger but still limited by geographical placement and scheduling.

Premise 2.—A reasonable basis for determining fares is the distance from origin airport A to destination airport B. Customers should accept this as it appears logical to assume that a longer trip will be priced higher than a shorter trip. Airlines should also accept this premise for the same reason and because it will simplify the fare construction procedure considerably, while still retaining enough flexibility for the application of tapered rates, if desired.

Premise 3.—The domestic passenger airline industry acts as a public utility and is not competitive in terms of price. The CAB regulates this industry's operations and must approve all price structures. Between most airport pairs only one airline provides service during any selected portion of the day, causing the airlines to more closely resemble regulated monopolies much like other public utilities. Even when several airlines serve the same route the situation is one of oligopoly and not one of perfect competition. Airlines do compete, however, in terms of scheduling, cities served, equipment furnished, ground service and in-flight amenities, and certain promotional appeals. This competition may be viewed as analogous to that observed between the various communications companies (telephone, telegraph, teletype) and between energy companies (electricity and natural gas).

IV. DEVELOPMENT OF PRICING PROCEDURE

A. Basic Distance Model

A given area may be defined and x and y distance coordinates
constructed for any desired points within the area. The distance between two points, A and B, may be calculated from:\textsuperscript{29}

\[ d_{AB} = \sqrt{(x_A - x_B)^2 + (y_A - y_B)^2} \]

Because the earth is not a flat surface some modification of this formula is needed since the linearity assumption will introduce noticeable errors on longer routes. The use of spherical coordinates and changing the distance formula to calculate arc length would correct this shortcoming and also would enable the method to be applied to intercontinental routes.

Thus, the distance, \( d_{AB} \), between two points on the earth, A and B, may be calculated from the arc length formula:\textsuperscript{30} \cos d = (\sin a \sin b) + (\cos a \cos b \cos P) \) in which:

\[ d = \text{arc distance between A and B} \]
\[ a = \text{latitude of A} \]
\[ b = \text{latitude of B} \]
\[ P = \text{degrees of longitude between A and B}. \]

Solving for arc length \( d \) (in degrees of latitude) and multiplying by 69 statute miles per degree or 111 kilometers per degree will give the desired measure, \( d_{AB} \):

\[ d_{AB} = d \times 69 \text{ (in miles)} \]

or

\[ d_{AB} = d \times 111 \text{ (in km)}. \]

Every airport in the United States may then be identified by one pair of latitude and longitude coordinates. A table of all commercial airports, their latitudes and longitudes,\textsuperscript{31} and the above formulas would constitute sufficient information to determine the distance between any airport pair.

B. Basic Tariff Model

The base price, \( b \), of a trip from airport A to airport B will be proportional to the distance from A to B, according to:

\[ b = d_{AB} \times r \]

where \( r \) is some rate per unit of distance (\$/mile or \$/km). The

\textsuperscript{29} G. Thomas, Jr., Calculus and Analytic Geometry 7 (1960).
\textsuperscript{30} A. Robinson, Elements of Cartography 23 (2d ed. 1960).
\textsuperscript{31} One firm, Centre Mark Company, Elmhurst, Illinois, supplies a data base file, called CENTRE-US, of specific locations identified by latitude and longitude (and other codes).
basic ticket price, \( p \), may be altered by a multiplier designating the class of service (coach class, first class, or other) \( c \), so that:

\[
p = b \times c = d_{AB} \times r \times c.
\]

If coach class were considered to be the basic price, a reasonable assumption since most passengers are carried in coach sections, the class multiplier might be:

\[
c = 1.00 \text{ for coach class} \\
c = 1.30 \text{ for first class.}^{29}
\]

If other classes of service are instituted, as has been done in the past, the multiplier, \( c \), can conveniently reflect these class relationships. Even the so-called promotional fares may be handled by simply making \( c \) some fractional part of 1.00.

The basic tariff model will now be applied to routes of increasing complexity and extended to cover these cases.

*Case 1*: Airline provides direct service from A to B. The fare would be determined by the basic tariff model:

\[
p = d_{AB} \times r \times c.
\]

*Case 2*: Airline provides service from A to B, but with an intermediate stop at airport C. This case includes a possible plane change at C, but assumes the trip continues on the same airline at the same class. The fare for the passenger traveling from A to B is still:

\[
p = d_{AB} \times r \times c.
\]

While the distance traveled by the aircraft was longer, this was at the convenience of either the airline, the regulatory agency, or both, and no benefit was received by the customer. In fact, the customer may be inconvenienced by the extra time expended and the disruption in the continuity of the trip.

*Case 3*: One airline provides service from A to C, while a second airline provides connection from C to B. The price paid by the customer traveling from A to B will still be:

\[
p = d_{AB} \times r \times c.
\]

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As in Case 2, the fare is not based on the sum of the distances $d_{AC}$ plus $d_{CB}$ because the customer maintained no control over the schedules of the connecting airlines or the placement of connecting point C. He should not be penalized for a trip involving these factors. As an extension of the pricing formula, the amounts of revenue realized by each airline may be allocated. These amounts will be proportional to the distance between the origin, destination and interchange point, as follows:

\[
P = \frac{d_{AB} \times r \times c \times d_{AC}}{(d_{AC} + d_{CB})} + \frac{d_{AB} \times r \times c \times d_{CB}}{(d_{AC} + d_{CB})}.
\]

**Case 4:** One of the connecting airlines makes an additional intermediate stop at E before reaching the interchange airport C. Probably the best way to handle this case is to still consider only distance $d_{AC}$ for the first airline rather than $d_{AC} + d_{EC}$. This procedure will be consistent with the argument that neither the passenger nor the second airline had any control over the intermediate stop made by the first airline. Also, standard ticketing practice indicates only changes of flights, identified by airline and flight number; intermediate stops on the same flight are not considered.

**Case 5:** The first portion of the trip, A to C, is made at one class of service and the concluding portion, C to B, is made at another class. This is currently one area of inequity. Although combination fares involving changes of planes and changes of airlines are calculated for coach service and for first class service, combinations of coach and first class on different airlines frequently result in little or no reduction from the all first class fare. The extension of the pricing formula in Case 4 alleviates any such problem. Each portion of the formula contains a class multiplier, $c$. Therefore, on any portion of the trip ticketed at other than the base coach rate, the proportionate share, and only that share, will be adjusted.

**Case 6:** On a connecting flight, one airline is a major trunk line and the other is, for example, a local service airline. The problem presented here is one of apportionment of fares between the two carriers. It has been pointed out that average revenue per mile on local service routes generally must be higher than for trunk lines because of the short run, low density, higher cost nature of the
local carriers. Since each portion of the pricing formula also contains a rate multiplier, \( r \), a tapered or sliding rate scale may be used. One such rate currently used by the CAB for distributing revenues from joint fares starts at $0.216 per mile on routes up to fifty miles and declines to $0.045 per mile for distances of 2,500 miles or more. These rates reflect the average per mile revenues received by the local service and trunk lines of $0.093 and $0.061, respectively.

**Case 7:** More than two airlines are included on an interconnecting ticket. The general pricing formula may now be stated:

\[
 p = \sum_{i=1}^{n} \left( \frac{d_{ab} \times r_i \times c_i \times d_i}{\sum_{i=1}^{n} d_i} \right)
\]

where:

- \( i \) = flight number (for example, 1 from A to E, 2 from E to F, etc., up to flight \( n \) from G to B)
- \( r_i \) = line haul rate for flight \( i \)
- \( c_i \) = class of service for flight \( i \)
- \( d_i \) = distance, flight \( i \), from passenger's boarding point to his disembarking point, ignoring intermediate stops
- \( d_{ab} \) = distance from passenger's origin airport A to his destination airport B.

**C. Example**

What happens when the change point \( C \) is further from A than the destination B, i.e. when the passenger in effect retraces part of his route? For example, consider a trip from Denver to Reno, a distance of 793 miles. If scheduled direct flights were not available at times convenient for the customer, he might fly directly to San Francisco, 956 miles west, and there change planes for Reno, 192 miles northeast. For purposes of illustration assume that the

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34 *CAB Plans to Cushion Joint Fare Impact*, 96 AV. WEEK & SPACE TECHNOLOGY, April 17, 1972, at 23.
trip was taken during a holiday period and the coach class section from San Francisco to Reno was completely booked, leaving only the first class section available for the passenger. The coach fare between Denver and Reno is $65 while $84 is the charge for first class.\textsuperscript{87} Recalling that the base fare was:

\[ b = d_{ab} \times r \]

solving for \( r \) gives:

\[ r = \frac{b}{d_{ab}} \]
\[ r = \frac{65}{793} \]
\[ r = $0.082/\text{mi.} \]

The ticket price will be computed by:

\[
p = \sum_{i=1}^{n} \left( \frac{d_{ab} \times r \times c_i \times d_i}{\sum_{i=1}^{n} d_i} \right)
\]

\[
p = 793 \times 0.082 \times 1.00 \times 956/(956 + 192) + \\
793 \times 0.082 \times 1.30 \times 192/(956 + 192)
\]
\[
p = 54.15 + 14.14
\]
\[
p = $68.29.
\]

This fare reasonably charges the passenger for services received by him. It is not as low as the coach fare because he benefited from first class services for part of the trip. Likewise, it is not nearly as high as a first class fare because he rode in a coach section for eighty-three percent of the distance. Finally, it is not as high as the fare to San Francisco ($77 coach, from Denver) because that was not his destination.

V. CONCLUSION

A. Implementation

Given the computer capabilities of most domestic airlines, the simple accounting routines developed above should present no problems whatsoever to program. If no change of plane or service class were to be encountered on a given trip, the only information necessary for pricing a ticket would be the origin and destination airports and the class of accommodations. Keying in the airport codes would recall from memory the longitude and latitude of each

\textsuperscript{87} United Air Lines, Our Friendly Times, June 1, 1973, at 108.
and distance $d_{AB}$ would be immediately calculated. If intermediate stops involving changes are involved, the ticket agent would also key in the airport codes for them, thus generating distances $d_i$. Since the rates, $r_i$, were assumed to be dependent upon distance, they would probably be programed as a function of $d_i$ and calculated next. The output should be the total price to be printed on the customer's ticket and the individual price breakdowns for the airlines' accounting system to properly credit each flight.

For travel agents without complete computer affiliation, a simple desk top programmable calculator could be utilized; these currently sell for several hundred dollars. It would be necessary for the agent to look up the coordinates for the individual airports involved and enter them on a keyboard, but the agent would not be required to perform further calculations. Those lacking even these resources could be requested to call the airlines for ticket quotations.

B. Arguments Against the Proposed Pricing System

Certain airlines may balk at this system because the linear pricing method does not take into account relationships between the high fixed costs of operations and relatively lower variable costs. These result in high break-even points with potentially profitable operations for the long-haul carriers and unprofitable returns for those lines with a preponderance of short routes. CAB examiner Robert M. Johnson has been reported as favoring a "dual element" pricing formula with a fixed terminal charge and a varying line-haul charge. The pricing system proposed in this article would be adaptable to a two stage formula by the addition of a constant. It should be noted, however, that a varying line haul rate with a high starting point, such as $0.25$ per mile for the first one hundred miles, gives the same effect as adding a terminal charge since most flights continue on for considerable distances.

The proposed pricing system may invite abuses. For example, in the trip taken by the Denver to Reno passenger, at one point in his travels he has arrived in San Francisco and has not paid as much as the normal Denver to San Francisco passenger. Some scheming customers may look for more of these double-back routings and schedule them, all the while intending to terminate their trip at the supposed interchange point, and pocket the savings. One

\[\text{See note 32 supra at 22.}\]
solution to this dilemma is to make such activity a federal offense
and hold the passenger liable for the correct fare to whatever point
he chooses. Also, check-in personnel would be instructed to route
baggage to the ticketed destination and not to some intermediate
point. Passengers with hand luggage could still pose a problem. Tic-
ket procedures commonly ascertain a mailing or billing address,
however, and these could be used if the abuses became trouble-
some. It is not felt, however, that the number of possible routes
and the number of participating customers would be significant
enough to alter the method of computation. There is one simple
way to alleviate the problem, although it would penalize a large
number of passengers. That would be to price the ticket for the
furthest airport visited, a procedure similar to the current rule for
constructing joint fares. Again, this procedure would overcharge
the majority of legitimate passengers and is not advised.

C. Chances for Adoption

One objective of this proposal was to introduce the marketing
concept into airline pricing policies. The first element of the mar-
ket concept is:

that marketing begins and ends with the needs and wants of cus-
tomers and society, not with the goals or objectives of the business
organization.9

Consumers Union has accused the CAB of “warm cooperation
with the airlines and cold neglect of the public."10 It also challenged
that:

Air travelers will undoubtedly continue to be overcharged until the
CAB stops concerning itself almost exclusively with the profit mar-
gins of the airline industry.41

It would appear that the need for the airlines to adopt procedures
developed with the marketing concept in mind has been estab-
lished. As described earlier, the attitude of the Board also appears
to be changing. Perhaps the time is right for a simplified, flexible,
equitable, computerized fare structure. The pricing method pro-
posed in this article may serve as a base for improving airlines’ re-
lationships with the traveling public to the benefit of both parties.

10 CAB Speaks Softly, at 692.
41 How Airlines Overcharge, at 322.