PEAK LOAD PRICING ON THE AUSTRALIA-U.S.A. AIR ROUTE

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ABSTRACT: *This paper attempts to estimate the peak/off-peak fares that would eliminate the variability of demand for leisure travel by Australian residents travelling to the USA. The variability of demand over time given a fixed capacity has led to an under and over utilisation of airline capacity at different times of the year. This has led to lower average load factors, which in turn has led to a higher average fare.*

The variability of demand over time is examined in the context of the airline industry; specifically the Australia-USA (Pacific) air route. Given that capacity has been predetermined and remains fixed for the medium term (eg 12 months), by allowing the fare to vary between travel seasons it is possible to maintain a fairly uniform load factor throughout the year.

The analysis of seasonal fares draws on the well developed theory of peak-load pricing and extending it to take into account the interdependency of demand.

Presented by Neil Aplin

INTRODUCTION

The 1978 Review of Australia's International Civil Aviation Policy stated that one of the major problems facing airline operators serving Australia was seasonal demand imbalance. Seasonal demand imbalance refers to the variability of travel demand over time; as a consequence, at certain times of the year demand exceeds supply (peak travel season) while at other times there is an excess of supply (off-peak travel season).

Scheduled airline operators serving Australia have their capacities fixed in the short run. Furthermore, seasonal demand imbalance is bi-directional; that is the peak travel demand from the northern hemisphere to Australia is not matched by the peak travel demand in the reverse direction. Generally, the capacity provided on any route is determined by the peak demand; as the peak travel seasons do not match the operators have to offer a consistently higher capacity level throughout the year. These factors tend to limit the operators ability to reduce capacity, which in turn leads to a lower average load factor and a higher cost per seat.

It has been observed that leisure travellers are generally prepared to trade off lower fares for lower product requirements. Airline operators have also noted that the leisure travel market is a growth market and consequently have increased the range of fares available to attract more leisure travellers.

Seasonal demand imbalance and the growth of leisure travellers has occurred on the Australia-U.S.A. air route (Pacific route). These factors provide the scenario for an application of peak load pricing. As leisure travellers are responsive to price changes, by varying the fares between travel seasons it is possible to influence the demand for travel at different times of the year. The seasonal fare differences encourage efficient use of airline resources and improve total passenger welfare. In addition, "since peak/off-peak pricing establishes an efficient basis for the registration and adjustment of demand, it therefore provides a rational economic basis for investment planning and determination of total airline capacity."(1)

The general rules in peak/off-peak pricing were demonstrated by Williamson:(2)

(i) the peak price would be above the long run marginal cost,

(ii) the off-peak price would at least cover the short run marginal costs.

Williamson's exposition of peak and off-peak pricing was based on the assumption of independent demands in the two periods. In fact, peak and off-peak demand for overseas leisure travel are not independent, and a major aim of this study has been to quantify the inter-relationship between travel seasons. As will be shown later, the solution to peak/off-peak pricing is more complex when all of the cross-relationships are known, but the basic principle remains the same.

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1. C.A. Gannon, "Pricing of domestic airline services - selected aspects of fare on Australia's competitive routes", The Domestic Air Transport Policy Review, (Canberra, A.G.P.S., 1979), Vol. II, p 113.

2. O.E. Williamson, "Peak-load pricing and optimal capacity under indivisibility constraints", American Economic Review, Vol. 56, No. 4, Part 1, 1966, pp 810-827.

MODEL SPECIFICATION AND DATA

To estimate the peak/off-peak prices that would stabilise the level of demand for travel over time, it is at first necessary to estimate the own price and cross price elasticities with respect to travel in each season. Thus the first step was to formulate an econometric model. As data for American residents travelling to Australia was not available the study was limited to estimating the price elasticities for Australian residents travelling to the U.S.A.

For Australian residents travelling to the U.S.A., the travel seasons were defined as: (3)

(i) off-peak: February, March, October and November;
(ii) shoulder: January, April, July and September;
(iii) peak: May, June, August and December.

The data used was monthly time series data from January 1974 to December 1980. The general relationship for this problem may be given as:

(Eq.1) LNT = f(LNOP, LNS, LNP, AXUS, AXUK, Y)

where

LNT = the number of trips per head of Australian leisure travellers travelling to the U.S.A.
LNOP = the real advanced purchase fare available in the off-peak period,
LNS = the real advanced purchase fare available in the shoulder period,
LNP = the real advanced purchase fare available in the peak period,
AXUS = the U.S.A. to Australia relative prices,
AXUK = the U.K. to Australia relative prices,
Y = the real per capita monthly disposable income.

The number of Australian leisure travellers travelling to the U.S.A. was obtained from the Australian Bureau of Statistics, Canberra. Only those Australian travellers who gave their main destination as the U.S.A. and were staying away for less than 12 months were used in the model. The demand of leisure travel to the U.S.A. was seen to depend on the fares available in each travel season. The relative prices variable was used to represent the attractiveness of the U.S.A. as a destination. The U.K. relative price variable was included in the model to represent a substitute destination. The demand for leisure travel is a derived demand, no one travels from point A to B purely for the travel experience. The destination choice makes up an important part of the total variation packages. Thus the prices at a destination country relative to the originating country would be expected to influence the length of stay of travellers and act as a proxy to costs other than fare.(4) The relative prices variable is a composite variable, generated by adjusting the exchange rate movements by the ratio of the U.S.A. consumer price index to

3. Department of Transport, Canberra, 1980.

4. For example of the importance of exchange rate movements with respect to travel see Artus (1972) and Jud and Joseph (1974).

the Australian C.P.I. The U.K. relative price variable is constructed in a similar fashion and is used to represent an alternative destination.

The fare variable used was the real advanced purchase fare (APEX) for two reasons. Firstly, the study concentrated on leisure travellers, given the characteristics of leisure travellers (i.e. price sensitive) it was felt that the majority of leisure travellers would use the lowest fare available on the Pacific route. Secondly, only three fare types were available from 1974 to 1980; first class fare, economy class fare and the APEX fare. Thus the lowest fare available on the Pacific route for the period under study was the APEX fare.

To estimate the demand elasticities there are two possible approaches. The first approach would be to set up a model for each season; thus the data would be partitioned into one for the off-peak season, one for the shoulder season and one for the peak season. Equation 1 would be used three times, once for each set of data.

However, in taking this approach the normal tests for serial correlation are not applicable. This is because by partitioning the data each observation does not follow in a consecutively monthly fashion. That is, there may be a considerable gap (number of months) between each observation. Therefore, to estimate three separate equations, may induce some bias in the serial correlation test statistic. Furthermore, as serial correlation is a typical problem associated with time series data it should be tested for. For this reason it was decided to pool the data and estimate the coefficients in a single equation form. The model took the following form.

(Eq.2)

$$\begin{aligned}\ln LNT = {} & a_1 DJ + a_2 DF + a_3 DM + a_4 DA + a_5 DMY + a_6 DJN \\ & + a_7 DJL + a_8 DAG + a_9 DST + a_{10} DOC + D_{11} DNV + D_{12} DDC \\ & + b_1 \ln OP + b_2 \ln S + b_3 \ln P \\ & + c_1 D_s(\ln OP) + c_2 D_s(\ln S) + c_3 D_s(\ln P) \\ & + c_4 D_p(\ln OP) + c_5 D_p(\ln S) + c_6 D_p(\ln P) \\ & + d_1 \ln AXUS \\ & + d_2 D_s(\ln AXUS) + d_3 D_p(\ln AXUS) \\ & + e_1 \ln AXUK \\ & + e_2 D_s(\ln AXUK) + e_3 D_p(\ln AXUK) \\ & + f_1 \ln RDYM \\ & + f_2 D_s(\ln RDYM) + f_3 D_p(\ln RDYM) \\ & + U\end{aligned}$$

where

ln LNT = the log of Australian leisure travellers per capita travelling to the U.S.A.
DJ = dummy January = 1; 0 otherwise,
DF = dummy February = 1; 0 otherwise,
DM = dummy March = 1; 0 otherwise,
DA = dummy April = 1; 0 otherwise,

DMY = dummy May = 1; 0 otherwise,
DJN = dummy June = 1; 0 otherwise,
DJL = dummy July = 1; 0 otherwise,
DAG = dummy August = 1; 0 otherwise,
DST = dummy September = 1; 0 otherwise,
DOC = dummy October = 1; 0 otherwise,
DNV = dummy November = 1; 0 otherwise,
DDC = dummy December = 1; 0 otherwise,
ln LNOP = the log of the published real advanced purchase low fares,
ln LNS = the log of the published real advanced purchase shoulder fares,
ln LNP = the log of the published real advanced purchase peak fares,
D_s = dummy representing months in the shoulder period:
January = 1
April = 1
July = 1
September = 1
zero otherwise,
D_p = dummy representing months in the peak period:
May = 1
June = 1
August = 1
December = 1
zero otherwise,
D_s(ln LNOP) = the log of the real advanced purchase low fare multiplied by the shoulder dummy,
D_s(ln LNS) = the log of the real advanced purchase shoulder fare multiplied by the shoulder dummy,
D_s(ln LNP) = the log of the real advanced purchase peak fare multiplied by the shoulder dummy,
D_p(ln LNOP) = the log of the real advanced purchase low fare multiplied by the peak dummy,
D_p(ln LNS) = the log of the real advanced purchase shoulder fare multiplied by the peak dummy,
D_p(ln LNP) = the log of the real advanced purchase peak fare multiplied by the peak dummy,
ln AXUS = the log of the U.S.A. to Australia relative prices,
D_s(ln AXUS) = the log of the U.S.A. relative prices multiplied by the shoulder dummy,
D_p(ln AXUS) = the log of the U.S.A. relative prices multiplied by the peak dummy,
ln AXUK = the log of the U.K. to Australia relative prices,
D_s(ln AXUK) = the log of the U.K. relative prices multiplied by the shoulder dummy,
D_p(ln AXUK) = the log of the U.K. relative prices multiplied by the peak dummy,
ln RDYM = the log of the real per capita Australian monthly disposable income,
D_s(ln RDYM) = the log of the real per capita Australian monthly disposable income multiplied by the shoulder dummy,
D_p(ln RDYM) = the log of the real per capita Australian monthly disposable income multiplied by the peak dummy,
U = an additive disturbance term.

a_1 to a_{12}, b_1 to b_3, c_1 to c_6, d_1 to d_3, e_1 to e_3 and f_1 to f_3 are parameters to be estimated.

The single equation specification is actually a combination of the three separate equations. By using dummy variables to create interaction terms it is possible to switch the independent variables on and off depending on which season the dependent variable represents.

RESULTS OF THE SINGLE EQUATION

By using the single equation it was possible to detect serial correlation. The results in Table 1 indicate the existence of serial correlation (Durbin-Watson statistic is 1.58). The equation was estimated in double log form.

TABLE 1

ESTIMATED COEFFICIENTS FOR THE DEMAND FOR LEISURE TRAVEL BY AUSTRALIAN RESIDENTS TRAVELLING TO THE U.S.A. (Eq.2)

INDEPENDENT VARIABLE	COEFFICIENT	t STATISTIC
DJ	-8.0752	-1.038
DF	6.2097	0.5613
DM	6.5262	0.5929
DA	-7.9276	-1.0271
DMY	-3.3827	-0.4415
DJN	-3.6871	-0.4818
DJL	-7.6488	0.9924
DAG	-3.3716	-0.4388
DST	-7.8549	-1.0165
DOC	6.6208	0.5962
DNV	6.4145	0.5754
DDC	-3.2871	-0.4202
LNOP	-0.8938	-3.2774
LNS	-0.4746	-0.9441
LNP	-0.0573	-0.0622
D_sLNOP	0.8456	1.9769
D_sLNS	-0.5112	-0.7244
D_sLNP	0.6345	0.4195
D_pLNOP	0.7566	2.0017
D_pLNS	1.1814	1.6132
D_pLNP	-1.1637	-0.0462
lnAXUS	-0.7236	-0.9856
D_sAXUS	-3.3029	-2.48
D_pAXUS	-2.3891	-2.6883
lnAXUK	2.6597	3.898

TABLE 1

INDEPENDENT VARIABLE	COEFFICIENT	t STATISTIC
D_sAXUK	-2.7176	-2.1146
D_pAXUK	-0.4614	-0.4419
lnRDYM	-1.0882	-0.8857
D_sRDYM	1.3727	0.9971
D_pRDYM	0.8882	0.5539
R^2	0.9448	
D.F.	54	
D.W.	1.584	

The presence of serial correlation indicates that the residuals are not independent of each other, thus the test statistics are unreliable. Fortunately, serial correlation can be corrected for by using the Cochrane-Orcutt transformation. The results of the next stage of estimation are presented in Table 2.

TABLE 2

ESTIMATED COEFFICIENTS FOR TRAVEL DEMAND BY AUSTRALIAN RESIDENTS TRAVELLING TO THE U.S.A. WITH COCHRANE-ORCUTT TRANSFORMATION (Eq.2.1)

INDEPENDENT VARIABLE	COEFFICIENT	t STATISTIC
DJ	-12.2765	-1.4784
DF	7.3378	0.6564
DM	7.6607	0.6888
DA	-12.0588	-1.4662
DMY	-3.1491	-0.3968
DJN	-3.4605	-0.4365
DJL	-11.7818	-1.4346
DAG	-3.1505	-0.3959
DST	-12.0122	-1.4585
DOC	7.7465	0.6902
DNV	7.5352	0.6686
DDC	-3.0732	-0.3793
LNOP	-0.8351	-3.0235
LNS	-0.5633	-1.2149
LNP	-0.3216	-0.3542
D_sLNOP	0.7556	1.9123
D_sLNS	-0.3943	-0.6343
D_sLNP	1.2093	0.8347
D_pLNOP	0.8189	2.2374
D_pLNS	1.1953	1.8052

TABLE 2

INDEPENDENT VARIABLE	COEFFICIENT	t STATISTIC
D_pLNP	-1.1215	-0.9556
lnAXUS	-0.5575	-0.7679
D_sAXUS	-3.84	-2.8516
D_pAXUS	-2.4038	-2.8674
lnAXUK	2.6473	4.0571
D_sAXUK	-2.8864	-2.3391
D_pAXUK	-0.171	-0.1677
lnRDYM	-0.9749	-0.7631
D_sRDYM	1.6153	1.7385
D_pRDYM	0.9115	0.5611
R^2	0.9469	
D.F.	53	
D.W.	2.13	

The result in Table 2 shows that the Durbin-Watson statistic is now 2.13. By using the Cochrane-Orcutt transformation on the data, serial correlation is no longer a problem. All the test statistics are now unbiased.

Demand Elasticities

By using a double log specification, the elasticities may generally be read directly from the equation. However, the specification of the model requires an additional step before the demand elasticities can be obtained.

The model contains the original non dummy variable (LNOP, LNS, LNP, AXUS, AXUK, RDYM); the coefficients for these variables represent the base period. In this case they are the demand elasticities for the off-peak season. The coefficients on the interaction terms (dummy variables x original variables e.g. D_sLNOP, D_pLNOP, etc.) represent the marginal changes in that season relative to the base period. Thus to obtain the travel demand elasticities for the shoulder season, the respective coefficients (D_sLNOP, D_sLNS, D_sLNP, D_sAXUS, D_sAXUK, D_sRDYM) must be added to the base coefficients. Table 3 shows the results of this additional step.

TABLE 3

COMPUTED TRAVEL DEMAND ELASTICITIES FROM Eq.2.1

TRAVEL PERIOD VARIABLES:		LOW	SHOULDER	PEAK
1. FARE				
	OFF-PEAK	-0.8351	0.0795	-0.0162
	SHOULDER	-0.5633	-0.9576	0.632
	PEAK	-0.3216	0.8897	-1.4431
2. RELATIVE PRICES				
	U.S.A.	-0.5575	-4.3975	-2.9613
	U.K.	2.6473	-0.2391	2.4763
3. INCOME		-0.9749	0.6404	-0.0634

The result shows that not all the variables carry the expected signs and only a few variables are statistically significant. To overcome this, a demand elasticity matrix was set up, the elasticities were then constrained to meet the four known laws of demand, that is: (5)

(i) HOMOGENEITY - the price, cross price and income elasticities sum to zero in each demand equation.

(ii) SYMMETRY - if E_{ij} is the cross price elasticity of demand for i with respect to j and E_{ji} is similarly defined, then

$$E_{ij} = (R_j/R_i)E_{ji} + R_j(E_{jy} - E_{iy})$$

where R_j and R_i are proportions of the total expenditure and E_{ij} and E_{jy} are income elasticities of demand.

(iii) COURNOT COLUMN AGGREGATION $\sum_i R_i E_{ij} = -R_j$

(iv) ENGEL AGGREGATION $\sum_i R_i E_{ij} = 1$

The elasticities derived from this process are shown in Table 4.

SOLUTION

The elasticities derived in Table 4 are used to determine the optimum fares for each travel season. The inter-dependency of demand for travel between seasons require that the solution be solved simultaneously. The three travel seasons can be represented by three demand equations, these are:

(Eq.a) $\ln X_L = \ln a_L - 2.2 \ln(\text{OFF PEAK FARE}) + 0.4 \ln(\text{SHOULDER FARE}) + 0.79 \ln(\text{PEAK FARE})$

(Eq.b) $\ln X_S = \ln a_S + 0.3 \ln(\text{OFF PEAK FARE}) - 2.3 \ln(\text{SHOULDER FARE}) + 0.99 \ln(\text{PEAK FARE})$

(Eq.c) $\ln X_P = \ln a_P + 0.34 \ln(\text{OFF PEAK FARE}) + 0.58 \ln(\text{SHOULDER FARE}) - 2.0 \ln(\text{PEAK FARE})$.

where

	Travellers
$\ln X_L$ = the log of the number of leisure travellers in the low period,	6,305
$\ln X_S$ = the log of the number of leisure travellers in the shoulder period,	6,332
$\ln X_P$ = the log of the number of leisure travellers in the peak period,	10,545

Off Peak fare : \$239.23, in 1970 dollars,
Shoulder fare : \$338.85, in 1970 dollars,
Peak fare : \$455.72, in 1970 dollars,

$\ln a_L$ = the log of the prices of all other goods and services in the off peak season,

5. J.H.E. Taplin, "A coherence approach to estimates of price elasticities in the vacation travel market", Journal of Transport Economics and Policy, 1980, pp 19-35.

TABLE 4

THE SYNTHESIZED MATRIX OF DEMAND ELASTICITIES FOR AUSTRALIAN LEISURE TRAVELLERS ON THE PACIFIC ROUTE IN THREE TRAVEL SEASONS

DEMAND FOR	ELASTICITY OF DEMAND WITH RESPECT TO:							
	Low Fare	Shoulder Fare	Peak Fare	Relative Prices U.S.A.	Relative Prices U.K.	Income	Other Goods & Services	% Share Expenditure
1 Travel in the Low Season	-2.2	0.4	0.79	-3.12	2.65*	1.5	0.01	0.0475
2 Travel in the Shoulder Season	0.3	-2.3	0.99*	-4.4*	3.88	1.5	0.03	0.0658
3 Travel in the Peak Season	0.34	0.58*	-2.0	-2.96*	2.48*	1.49	0.08	0.11138

* Elasticities from the single equation

$\ln a_s$ = the log of the prices of all other goods and services in the shoulder season,

$\ln a_p$ = the log of the prices of all other goods and services in the peak season.

The calculated values of the ln a_i's were: [6]

$$\ln a_L = 13.7551$$
$$\ln a_s = 14.4487$$
$$\ln a_p = 16.3208$$

To solve for the optimum fares, it is more convenient to present the problem in matrix form:

$$\underset{E}{\begin{bmatrix} -2.2 & 0.4 & 0.79 \\ 0.3 & -2.3 & 0.99 \\ 0.34 & 0.58 & -2.00 \end{bmatrix}} \underset{P}{\begin{bmatrix} \ln \text{(OFF PEAK FARE)} \\ \ln \text{(SHOULDER FARE)} \\ \ln \text{(PEAK FARE)} \end{bmatrix}} \underset{X}{\begin{bmatrix} \ln(10{,}545) - 13.7551 \\ \ln(10{,}545) - 14.4487 \\ \ln(10{,}545) - 16.3208 \end{bmatrix}}$$

where

E = the fare elasticity matrix
P = the fare column vector
X = the capacity column vector

The figure 10,545 was the number of Australian leisure travellers travelling to the U.S.A. in the last observed peak month (December 1980). The figure was assumed to represent the maximum number of travellers in any month. It does not represent a 100% load factor.

Generally the level of capacity offered on any one route is determined by the demand for travel in the peak period. In the short run capacity is fixed, thus if 10,545 seats were provided each month only a small part of this capacity would be used in the off-peak. However, by adopting an appropriate set of fares, it may be possible to increase demand in the off-peak periods while encouraging some peak travellers to travel in other seasons.

To solve for the optimum fares the equation is rearranged. [7]

$$\underset{E^{-1}}{\begin{bmatrix} -0.517 & -0.1605 & -0.279 \\ -0.1193 & -0.5357 & -0.3101 \\ -0.1201 & -0.1813 & -0.636 \end{bmatrix}} \underset{Y}{\begin{bmatrix} -4.4919 \\ -5.1853 \\ -7.0574 \end{bmatrix}} = \underset{P}{\begin{bmatrix} \$167.94 \\ \$245.22 \\ \$390.75 \end{bmatrix}} \begin{matrix} \text{Off Peak} \\ \text{Shoulder} \\ \text{Peak} \end{matrix}$$

The optimum fares are calculated for 70%, 80%, 90% and 100% of the number of travellers in the peak season (10,545). The results are in Table 5.

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6. The calculated values of ln a_i's were:

(Eq.a) $\ln(6{,}305) = \ln a_L - 2.2 \ln(239.23) + 0.4 \ln(338.85) + 0.77 \ln(455.72)$

$\Longrightarrow$ $8.7491 = \ln a_L - 5.006$

$\ln a_L = 13.7551$

7. Fares are in 1970 Australian dollars.

TABLE 5

OPTIMUM FARES FOR 70%, 80%, 90% and 100% OF THE NUMBER OF TRAVELLERS IN THE PEAK SEASON

Percentage of Peak Travellers	SEASON		
	Low	Shoulder	Peak
70%	236.23	345.42	545.91
80%	207.86	304.13	481.65
90%	185.76	271.03	431.34
100%	167.94	245.22	390.75
Actual	239.23	338.85	455.75

For illustrative purposes, if the airlines did lower the number of seats offered for APEX passengers to 10,545, they would probably be aiming for an average load factor of 80% (of 10,545). The appropriate fares to charge are $207.86, $304.13 and $481.65 for the low, shoulder and peak seasons respectively (in 1970 Australian dollars).

Using the price elasticities in Table 4, it is possible to estimate the net effect of changing the fares from those offered in 1980 to the optimal fares calculated above. The low fare decreases by 13.10%, the shoulder fare by 9.76% and the peak fare increases by 5.69%: the change in the number of travellers for each travel season is shown in Table 6.

TABLE 6

THE NET EFFECTS OF USING THE OPTIMUM FARE AT 80% OF THE PRESENT TRAVELLERS IN THE PEAK SEASON

	Change in the Number of Travellers		
	Low	Shoulder	Peak
The Effect of Decreasing the Low Fare by 13.10%	2,124	-290	-423
The Effect of Decreasing the Shoulder Fare by 9.76%	-288	1,658	-537
The Effect of Increasing the Peak Fare by 5.69%	323	416	-1,080
Net Effect	2,159	1,784	-2,040
Present Loadings	6,305	6,334	10,545
New Loadings	8,464	8,118	8,505

The new loading figures should be approximately 80% of 10,545 travellers for all travel seasons. Because of rounding errors the patronage levels in the three seasons are slightly different.

The effect of the new set of fares has been to increase the patronage levels in the low and shoulder seasons while decreasing the number of travellers in the peak. The use of peak load pricing is not simply to suppress demand in the peak but to make the peak users realise the actual cost they are imposing on the system.

COSTS - ESTIMATES OF THE SHORT AND LONG RUN MARGINAL COSTS

The operating costs are taken from the Civil Aeronautics Board Bulletin on Aircraft Operating Costs.(8) The operating costs used here are for Pan Am's Boeing 747 used on the Pacific route for 1978. To make the cost figures comparable to the estimated fares, the cost figures were deflated to 1970 values.

The total direct operating cost (flying operations and direct maintenance and depreciation on flight equipment) per block hour(9) is U.S.A. $3,745.88.(10) The flying time between Australia and the U.S.A. is approximately 16 hours. Thus the total operating cost of a flight from Australia to the U.S.A. is $53,704.38 (1970) Australian dollars. Table 7 shows the operating cost for various load factors.

TABLE 7

SHORT RUN MARGINAL COSTS PER SEAT ON THE PACIFIC ROUTE, 1970 AUSTRALIAN DOLLARS

LOAD FACTOR (%)	NUMBER OF SEATS OCCUPIED	SHORT RUN MARGINAL COSTS ($)
100	397	135.28
90	357	150.44
80	318	168.89
70	278	193.19

Long Run Marginal Costs

The long run marginal costs (L.R.M.C.) are estimated from Douglas and Miller's estimate of the L.R.M.C. for U.S.A. domestic operators. Douglas and Miller estimated ownership costs to be $1,619.43(11) (1970) Australian dollars per block hour. Thus the ownership cost for one flight on the Pacific route (16 hours flying time) is A$25,910.88. The administrative costs and pre-operating expenses per passenger mile is 1.65(12) Australian cents (deflated to

8. Civil Aeronautics Board, Aircraft Operating Cost and Performance Report, Washington D.C., 1979), Vol. 13.
9. Block hour is the elapsed time between the departure from the origin gate to the arrival at the destination gate.
10. C.A.B., Aircraft Operating Costs, (Washington D.C., 1979), Vol. 13, p 84.
11. G. Douglas and J. Miller, Economic Regulation of Domestic Transport, 1974, p 23.
12. Ibid, p 8.

1970). For a full plane the administrative costs and pre-operating expenses amount to A$58,954.50. The total starting up cost for a full plane is $84,865.38. Table 8 shows the long run marginal costs for various load factors.

TABLE 8

STARTING UP COSTS AND LONG RUN MARGINAL COSTS ON THE PACIFIC ROUTE

LOAD FACTOR (%)	NUMBER OF SEATS OCCUPIED	STARTING UP COSTS (1970 $)	OPERATING COSTS (1970 $)	LONG RUN MARGINAL COSTS (1970 $)
100	397	213.77	135.28	349.05
90	357	237.72	150.44	388.16
80	318	266.88	168.89	435.77
70	278	305.28	193.19	498.47

POLICY IMPLICATIONS

In economics the primary role of prices is the achievement of efficient resource allocation. The failure to facilitate prices in this role would necessarily lead to an inefficient use of resources. This is highlighted by the peaks and troughs in the number of Australian travellers to the U.S.A. prior to 1979.

The existence of significant cross elasticities between travel seasons, meant that the optimum fares could not be set by the own price elasticities alone. Thus the solution is slightly more complex, but the general rules of peak load pricing still apply. If the operators were to offer 80% of the present peak loading (this is not the load factor, it is 80% of 10,545 Australian leisure travellers who travelled to the U.S.A. in the last observed peak month), the optimum fares and their relevant costs are given in Table 9.

TABLE 9

OPTIMUM FARES AND THEIR COST OF OPERATIONS IN EACH SEASON AT 80% OF THE PRESENT PEAK TRAVELLERS

SEASON	NUMBER OF SEATS OCCUPIED	FARES (1970 $)	COSTS (1970 $)
OFF PEAK	318	207.86	168.89
SHOULDER	318	304.13	168.89
PEAK	318	481.65	435.57

It can be seen from Table 9 that the fares are consistent with Williamson's general solution for peak/off-peak pricing, where:

(i) the off-peak and shoulder fares at least cover the short run marginal cost, and;
(ii) the peak fare is above the long run marginal cost.

By using these optimum fares, a higher average load factor may be achieved. The increase in load factor acts to reduce the cost per seat. Gains can thus be made by operator and consumer. Further, the operator now has a rational economic basis for capacity determination and investment planning.

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ESTIMATION OF AN AGGREGATE PRODUCTION FUNCTION USING POOLED CROSS-SECTION TIME-SERIES DATA FOR AUSTRALIAN RAILWAYS

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ABSTRACT: *The aim of the study is to estimate a production function representing the technological relationship between output and factor inputs.*

The virtue of estimating a production function is that it provides a better indication of capital and labour productivity, because it shows the separately attributable increments of output due to a unit increase in labour and to a unit increase in capital. It also provides a measure of the true marginal factor productivity, which is vastly superior to input-output ratios which fail completely to distinguish between the contributions of the factors to output.