Demand Analysis for International Air Travel

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Time-series models for 10 international air travel markets are calibrated. These models are used to analyze traffic developments and to investigate whether conventional models of traffic demand can be used to forecast international air traffic. The models use simple specifications in which demand is represented by per capita income and intercountry trade flows and supply is represented by prevailing fares. Because of data limitations, no attempt is made to model demand and supply simultaneously. The results of the analysis are encouraging and indicate that, although the use of traffic demand modeling in analyzing international air traffic has many limitations, there is a good potential for developing this methodology into a useful forecasting aid.

The use of econometric models of air travel demand has been common practice for many years. Such models are typically applied in setting pricing policy on the basis of estimated elasticities and in traffic forecasting on the basis of exogenous forecasts of the demand and supply variables of the models. Most applications of this type have, however, been confined to domestic air travel, and indeed most of this work has been limited to U.S. domestic air travel. Apart from some applications in the North Atlantic and the local European markets, few if any applications of econometric models can be found for any of the almost 20 major international air travel markets, as defined by the International Air Transport Association.

There are many reasons for this disparity in methodological development and application. Apart from the simple historic lag in the development of aviation between the United States and many other regions of the world, the most important reason probably has to do with the difficulty involved in assembling the information necessary for the development of econometric models.

Many countries in the world do not have the advanced data-management systems required to keep track of the development of aviation and related socioeconomic activities. It is very difficult, if at all possible, to find the parity between data systems that is required to establish a "market" data base. A market in this regard is defined as a pair of regions, each of which contains one or more countries and between which there is air travel activity of interest. Possibly the most important difficulty, however, is that the efficacy of modeling air travel between region pairs in the world can be questioned on the ground that little of the regularity that permits meaningful modeling exists between regions in patterns of development, travel behavior, supply characteristics, and determinants of demand.

In the face of these deterrents, an attempt has been made to investigate the feasibility of developing a set of econometric models for air travel in world markets. The purpose of this study is to calibrate such models and evaluate their efficacy for traffic forecasting. This paper reports on some of the findings of the study and focuses on the results of the analysis for the following 12 international markets, which cover a range of geographic areas and traffic densities: North Atlantic, Mid-Atlantic, South Atlantic, North America-South America, North America-Central America, Europe-Northern Africa, Europe-Southern Africa, local Europe, Europe-Far East/Australasia, North Pacific and Mid-Pacific, South Pacific, and local Far East/Australasia.

METHODOLOGY

Theoretically, it can be said that all variables used in traffic forecasting are dependent and should actually be combined into a single model system. This model system would be estimated simultaneously by using multivariate statistical techniques. Although this is true of demand analysis in general, no attempt was made in this study to undertake a simultaneous modeling effort. The main reason for this is that the data base used is rather fragmented and inadequate for complete multivariate analysis. Because of the limited data base, the models are calibrated individually and are thus short-term models that do not take into account long-term feedback effects between demand and supply. Any such effects would have to be inputted as scenarios in a repeated application of the forecasting process.

Another limitation in modeling traffic demand is that, since it cannot be assumed that the different markets have the same demand function, each market is analyzed separately. This means that the data base for each market has to come from historic data and that some sort of time-series analysis is appropriate. The model would have the following general form:

$$T_t = T(\underline{D}_t, \underline{S}_t, \underline{E}_t) \qquad (1)$$

where

- T_t = total market traffic in year t (revenue passenger kilometers),
- $\underline{D}_t$ = values in year t of a vector of socioeconomic demand variables,
- $\underline{S}_t$ = values in year t of a vector of supply variables, and
- $\underline{E}_t$ = independent error terms for each year.

Because it is anticipated that data problems will preclude any thorough time-series analysis or multivariate modeling of demand and supply, the specification of the models is kept to the simplest possible level. Indeed, it was with great difficulty that data for only seven years (1970 through 1976) were compiled for the study markets. Model specification is limited to a linear form and a multiplicative form with an exponential price function. By assuming that all annual errors are independent and identically distributed and avoiding to the extent possible the simultaneous specification of correlated variables of $\underline{D}$ or $\underline{S}$, the estimation is performed with multiple-regression analysis by using ordinary least squares. This choice of an estimation technique is again based on the limited number of observations available for the analysis.

Another choice severely limited by data availability is the choice of the explanatory variables. Demand variables are selected from among the following: (a) per capita disposable income representing nonbusiness traffic demand and (b) export-import trade representing business traffic demand. These variables are defined for each market by taking a weighted average of their values for selected countries that are representative of the regions that make up the market. The averages are weighted by the airline traffic of each of these countries. In some cases, the variable values for a single representative country are used when complete data on the demand variables are not available. Supply variables are selected from three: air fare, by using either lowest excursion fare or economy fare; market yield per passenger kilometer; and capacity in available seat kilometers. The fare variables are selected for a city pair that is considered representative in the market. All monetary variables are specified in current terms and in real terms deflated by consumer price indices constructed by using weighted averages for countries in either region of the market in question. In some cases in which there are insufficient data to permit the construction of a weighted average, a single-country consumer price index is used instead.

Different model forms were calibrated for each market. The form most commonly used and consistently most significant statistically is the multiplicative form. However, to permit the possibility of variations in price elasticities over time or to detect whether such variations exist, a model form in which the price variable is entered exponentially was calibrated. A model that has two demand variables (income and trade) and one supply variable (yield) would be expressed as follows:

$$T = a_1 \cdot (\text{income})^{a_2} \cdot (\text{trade})^{a_3} \cdot \exp[a_4 \cdot (\text{yield})] \qquad (2)$$

where the t subscript for year has been dropped from all variables for simplicity and where $a_1, \ldots a_4$, are the model parameters. In this model, the income and trade elasticities of demand are, respectively, a_2 and a_3. The yield elasticity, however, is not constant and is given by $[a_4 \cdot (\text{yield})]$. This model form consistently proved more significant than the one in which price elasticity is constant. The advantage of this form is that it recognizes a factor that has been found repeatedly in earlier demand studies—that elasticity is very low when the price is low and increases with the value of price itself.

Since there are anywhere from two to four variables in the traffic demand model and only six years of data on which to calibrate it, it should be recognized that considerable variation can be expected in the parameter values. Although all calibration results appear to be statistically significant at least at the 90 percent level and most at the 95 percent level, it is still very important to recognize the limitations of this type of model for forecasting. Recalibration with additional data is imperative if the model is to be used for forecasting beyond, say, three years.

Another cause for skepticism and extreme care in using traffic demand models for forecasting is that, for many markets that include developing countries, the efficacy of econometric modeling can be questioned on basic principles. Little regularity exists in these markets in patterns of development, travel behavior, and supply characteristics. In the Europe-Northern Africa market, for example—which is defined as including Western Europe and the countries of Africa south of Algeria, Morocco, and Tunisia and north of Angola, Zambia, and Mozámbique—it is hard to imagine that the same determinants of travel demand exist in both regions. A variable such as per capita disposable income is likely to mean much less in terms of travel demand in, say, Upper Volta than in France. Ideally, one would wish to seek other determinants of travel demand that might be suitable for the developing countries of the world, but here one encounters the problem of data availability and must limit the analysis to assumption and conjecture. The few data available on developing economies are typically compiled by international organizations such as the United Nations and cover "conventional" measures of economic activity such as gross national product and per capita income. Another reason for doubting the ability of econometric models to forecast over longer periods of time is the fantastic growth rates that are occurring in many of the developing parts of the world. Technological and economic developments are occurring at such a rate that what happens during a seven-year period for which one has data to construct a model may not be happening during the subsequent period over which one wishes to forecast. On the basis of all this, it is reiterated that the models should be used for short-term forecasting and their validity should be continuously rechecked against additional data. To facilitate a comparative analysis that might be interesting, no attempt was made to integrate elaborate models in markets where such are possible, such as the North Atlantic. Similar models were calibrated for all markets under study. Selected countries in the regions and markets for which demand models are calibrated are given in Table 1.

RESULTS OF TRAFFIC DEMAND MODELS

The results of the calibration of traffic demand models for 12 study markets are given in Table 2. The only market for which a model calibration was not successful was the Europe-Middle East market. There are two probable reasons for this:

1. The market has experienced significant increases in traffic during the 1970-1976 period and appears to be continually in a state of flux, which makes econometric modeling rather difficult.
2. Socioeconomic data for Middle Eastern countries were not available, and to base the traffic solely on demand variables for the European countries was unacceptable both theoretically and statistically.

The results for all of the other study markets appear to be significant statistically, the F-values being significant at at least the 90 percent level and the R^2-values above 85 percent and in most cases above 95 percent. These study markets represent quite a range in terms of market characteristics and traffic volumes and trends. The volumes vary between an average of 71 billion revenue passenger-km for the study period in the North Atlantic and slightly more than 7 billion revenue passenger-km in the Europe-Northern Africa market. Steady growth is seen in some markets such as the Europe-Middle East market, in which traffic nearly tripled during the study period, whereas relatively low rates of growth—approximately 4-5 percent/year—are observed in markets such as the North Atlantic and the North America-Central America markets. Some markets appear to be dominated by nonbusiness traffic, and the income variable appears as the one variable in the demand model; others exhibit a balance between business and nonbusiness traffic, and both the income and trade demand variables appear in the models. Yield elasticities of demand vary from a low of about -0.20 in the Europe-Northern Africa market to a high of about -0.3 in the North America-South America market (see Table 3). The first of these two markets is one in which recent increases in capacity appear to have induced additional traffic

Table 1. Selected countries within markets and regions.

Market	Region A	Region B
North Atlantic	United States, Canada	United Kingdom, France, Germany, Italy, Switzerland, Holland, Sweden
Mid-Atlantic	United States	United Kingdom, France, Germany, Holland, Spain
South Atlantic	France, Germany, Italy, Portugal, Spain, Switzerland	
North America-Central America	United States, Canada	Mexico, Jamaica, Bahamas, Netherlands Antilles
North America-South America	United States, Canada	Venezuela
Europe-Northern Africa	United Kingdom, France, Germany, Holland, Italy, Switzerland	
Europe-Southern Africa	United Kingdom	
Europe-Far East/Australasia	United Kingdom, France, Germany, Italy, Holland, Sweden, Switzerland	Australia, Japan
Europe-Middle East		
South Pacific	United States, Canada	Australia, New Zealand
North Pacific and Mid-Pacific	United States, Canada	Japan, Philippines
Local Far East/Australasia	Australia, New Zealand, Philippines, Japan	
Local Europe	United Kingdom, France, Germany, Italy, Spain, Sweden, Switzerland	

Table 2. Summary of demand model calibration.

Term	North America-South America	North America-Central America	North Atlantic	Mid-Atlantic	South Atlantic
Constant					
Value	-12.140	-16.698	3.452	-20.509	-6.466
Standard error	6.663	16.182	1.990	4.630	2.803
Trade					
Value	0.353			0.763	
Standard error	0.143			0.247	
Composite disposable income per capita					
Value	2.379	3.575	1.010	3.015	2.146
Standard error	0.842	1.907	0.232	0.612	0.363
Yield					
Value			-0.170	-0.197	
Standard error			0.097	0.082	
Fare					
Value	-0.0052	-0.012			-0.0017
Standard error	0.0029	0.005			0.0007
Capacity					
Value					
Standard error					
Average revenue passenger kilometers (000 000s)	7151	12 189	71 417	5804	5693
R^2	0.962	0.856	0.944	0.985	0.972
F	17.14	8.97	15.77	46.79	19.13

Table 2 (continued).

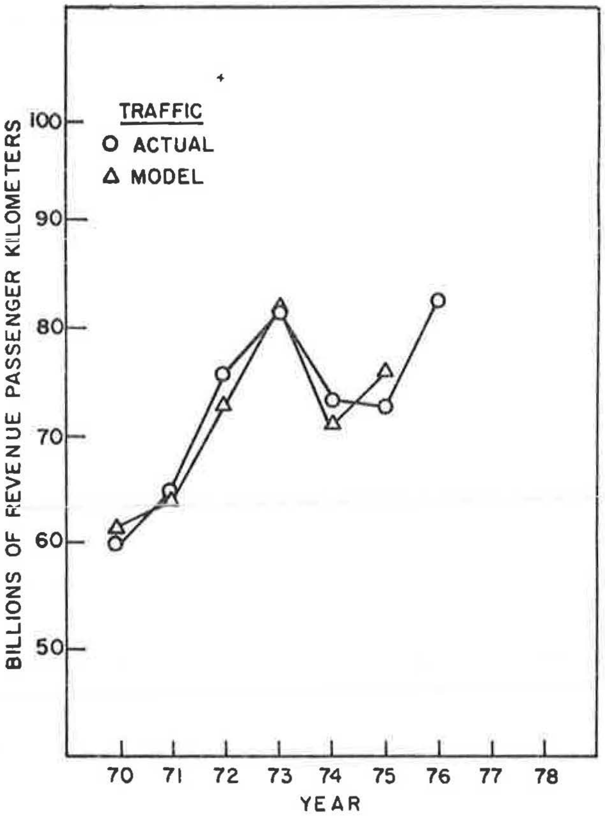
Term	Europe-Northern Africa	Europe-Southern Africa	Europe-Far East/Australasia	North Pacific and Mid-Pacific	South Pacific	Local Europe	Local Far East/Australasia
Constant							
Value	-3.383	-0.866	-8.633	-26.709	5.570	-8.878	-3.333
Standard error	1.398	4.380	6.664	16.540	1.055	4.052	0.593
Trade							
Value		0.561			0.550	1.666	
Standard error		0.172			0.122	0.374	
Composite disposable income per capita							
Value	0.399	0.979	2.431	4.850		0.839	0.616
Standard error	0.209	0.449	0.794	7.089		0.832	0.103
Yield							
Value	-0.047		-0.083		-0.505		
Standard error	0.026		0.164		0.064		
Fare							
Value		-0.003		-0.0032		-0.0049	-0.0006
Standard error		0.0004		0.001		0.0014	0.003
Capacity							
Value	0.996						0.825
Standard error	0.079						0.042
Average revenue passenger kilometers (000 000s)	4057	8593	26 981	12 375	4883	59 468	6641
R^2	0.997	0.975	0.973	0.884	0.967	0.951	0.999
F	239.27	26.22	55.54	8.14	58.78	12.99	1127.96

Notes: 1 km = 0.62 mile.
Constant and fare and yield variables are in exponential form.

Table 3. Elasticities of supply variable.

Market	Type of Elasticity	1970	1971	1972	1973	1974	1975	1976
North America-South America	Fare	-1.609	-1.711	-1.529	-1.472	-1.576	-1.565	-1.544
North America-Central America	Fare	-3.240	-3.156	-3.036	-3.000	-3.000	-2.832	-2.976
North Atlantic	Yield	-0.476	-0.471	-0.413	-0.411	-0.456	-0.449	-0.415
Mid-Atlantic	Yield	-0.686	-0.583	-0.544	-0.473	-0.376	-0.491	-0.481
South Atlantic	Fare	-1.404	-1.294	-1.309	-1.380	-1.176	-1.384	-1.241
Europe-Northern Africa	Yield	-0.209	-0.194	-0.218	-0.168	-0.144	-0.151	-0.155
Europe-Southern Africa	Fare	-2.289	-2.163	-2.184	-2.259	-2.112	-1.926	-1.740
Europe-Far East/Australasia	Yield	-0.313	-0.270	-0.242	-0.217	-0.207	-0.193	-0.194
North Pacific and Mid-Pacific	Fare	-2.470	-2.134	-2.262	-2.160	-1.978	-1.878	-1.709
South Pacific	Yield	-1.692	-1.601	-1.520	-1.505	-1.480	-1.252	-1.182
Local Europe	Fare	-0.891	-0.636	-0.624	-0.893	0.031	-0.891	-0.858
Local Far East/Australasia	Fare	-0.294	-0.279	-0.297	-0.260	-0.255	-0.267	-0.268

Figure 1. Comparison of actual and model traffic for North Atlantic market.



growth, and capacity appears as a variable in the demand model.

It is probably more profitable at this stage to look at the results of each market separately than to attempt a complete comparative analysis between markets. A complete comparative analysis would require an in-depth study of the various demand and supply factors as they differ from market to market.

Detailed results of the calibration for each market are shown in Figures 1-12. Each of the markets is discussed briefly below.

North Atlantic

The North Atlantic market is by far the largest of all the markets in the study in terms of traffic and capacity. The average over the study period is 71 billion revenue passenger-km; traffic in 1976 totaled more than 80 billion revenue passenger-km. The model used in this study represents a rather crude and aggregate one compared with the type that might be developed for this market. The North Atlantic is perhaps the only market in which traffic data would allow a detailed analysis of demand stratified by trip purpose. Indeed, a more detailed demand model of this market has been produced in an earlier study (1). However, for the sake of consistency in modeling and to provide for some comparative analysis with other markets, it was decided to include a model for the North Atlantic market that is similar in structure to the ones used elsewhere. In the computerized integrated forecasting process, it is possible to incorporate any model.

The model shown in Figure 1 includes income as a demand variable but not trade. This is not to say that business traffic is unimportant in this market. But, since more than 60 percent of traffic in the North Atlantic market is nonbusiness traffic, income remained as the only significant demand variable. Real yield elasticity is low at about -0.4 and appears stable over time.

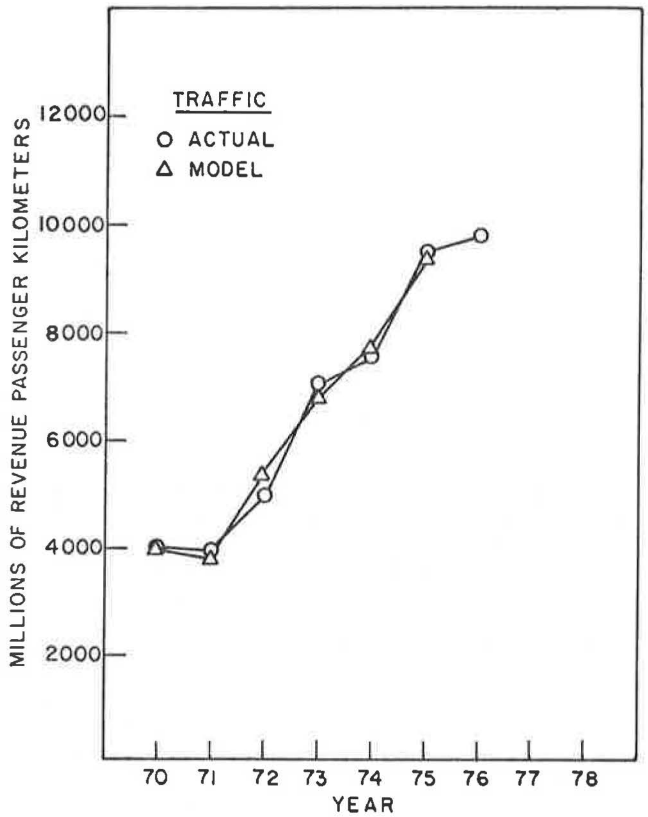
Mid-Atlantic

The interesting thing about the Mid-Atlantic market is that, although it is thought of as a market that connects Europe and the central and northern parts of South America, a considerable proportion of its traffic is in fact between Europe and the United States via Miami. For this reason we find that the variables in the model are composite for European countries and the United States. Thus, the variable of per capita income is a weighted average for Europe and the United States only because of the absence of a complete data set of income measures for the South American countries of the Mid-Atlantic market.

The Mid-Atlantic market is a low-volume market that in 1976 had only about 10 billion revenue passenger-km (the large stage length indicates a low passenger traffic volume). Except for two periods of depression in traffic—one in 1971 and the other in 1974—it has undergone relatively steady growth during the 1970-1976 period (see Figure 2). Trends in trade and per capita income together seem to reflect similar depressions: Trade declined significantly in 1971, and disposable income did not increase in real terms in 1974. Yield in the Mid-Atlantic market declined steadily until 1974, when it rose by about 25 percent. This does not, however, seem to have had a significant effect on traffic development, and one would expect that yield elasticity would be low in this market. Indeed, as the model shows, the elasticity has declined from -0.7 to -0.5 during the study period.

Charter traffic is insignificant in the Mid-Atlantic market, and the traffic demand model was constructed to include only scheduled traffic. The calibration re-

Figure 2. Comparison of actual and model traffic for Mid-Atlantic market.



sult shows both trade and income to be significant variables; income elasticity is a high +3.0 and trade elasticity a low +0.76. It would seem, then, that both business and nonbusiness traffic occur in this market and that, as expected, nonbusiness demand is more elastic than business demand.

South Atlantic

The South Atlantic market is another low-volume, long-haul market; traffic in 1976 was less than 7 billion passenger-km. Traffic growth has not been as fast as that in other markets, and it seems to have declined since 1976 (see Figure 3). Because data were not available for most of the South American countries of this market, it was not possible to represent the changes in economic development in these countries, such as important phenomena of growth in some (e.g., Brazil) and high inflation rates in others (e.g., Argentina). The market demand model is based solely on European economic indicators, a deficiency that ought to be remedied if additional data become available.

Charter traffic appears insignificant in this market as a percentage of the total traffic, and therefore the model is calibrated for scheduled traffic only. The calibration results show two interesting phenomena for this market. One is that income is the only demand variable found to be significant, which indicates that nonbusiness traffic predominates. The other is that fare rather than yield appears to be the significant price variable. One reason for this could be the fact that yield did not decline much in real terms, and this results in a positive correlation with traffic and precludes yield as a significant price variable. Besides, there is not a wide choice of fares in the South

Figure 3. Comparison of actual and model traffic for South Atlantic market.

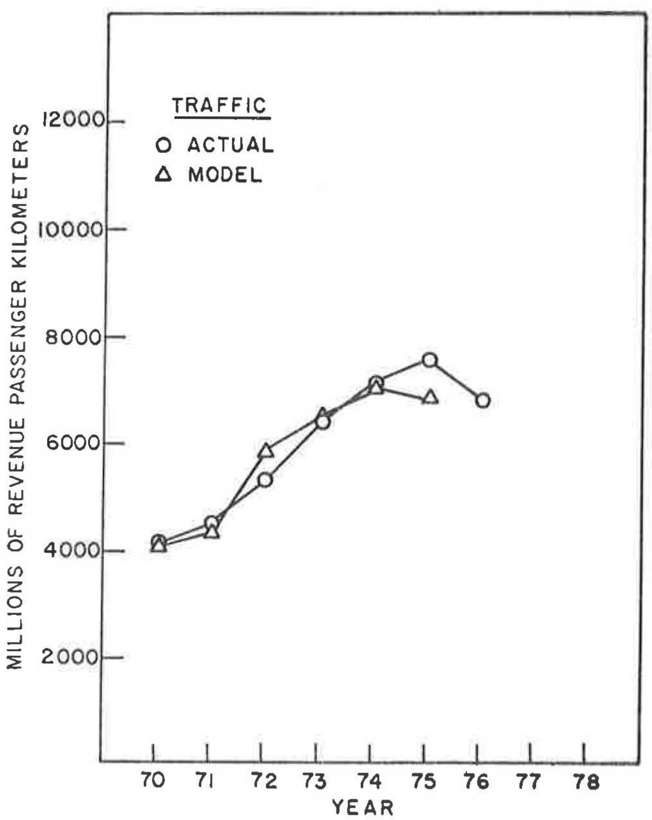
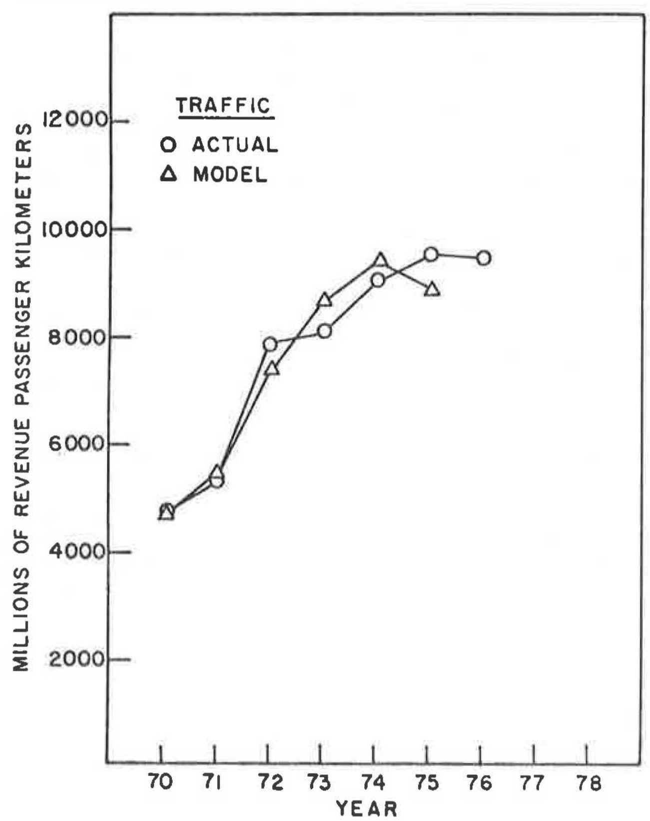


Figure 4. Comparison of actual and model traffic for North America-South America market.



Atlantic market. The Paris-Rio de Janeiro economy fare is the price variable for the model.

Income in the South Atlantic market exhibits an elasticity of +2.1, and the fare elasticity varies between -1.4 and -1.2. None of these values are unexpected for traffic that may be predominantly nonbusiness.

Although the model fit appears statistically acceptable, it is important to restate the reservation concerning the absence of demand variables for the South American countries and the need to update the data base for that region.

North America-South America

The North America-South America market has lower traffic volumes than the North America-Central America market. It experienced moderate growth throughout the study period and had traffic volumes of about 5 billion and 9 billion revenue passenger-km in 1970 and 1976, respectively (see Figure 4). It is a market that serves both business and nonbusiness travel. Both trade and income appear in the traffic model as variables of demand, although income elasticity (+2.38) is significantly larger than trade elasticity (+0.35). This can be expected, since trade experienced sharp growth during the study period whereas income barely increased.

The North America-South America market has no significant charter traffic, and no such traffic was included in the demand model. Fare rather than yield is used as the price variable, as it was in the North America-Central America market, and the excursion fare between Miami and Lima is used as a representative market fare. The fare elasticity, -1.50, is lower (in absolute terms) than that for the North America-Central America market, possibly because of the presence of business traffic. Perhaps for the same reason, income elasticity is also lower.

North America-Central America

The North America-Central America market is a medium-sized, short-haul market that had a traffic volume of approximately 11 billion revenue passenger-km in 1976. The market experienced strong growth prior to 1972, after which traffic appears to have stabilized (see Figure 5). Since it is a market of predominantly vacation traffic, only income appears in the models as a demand variable. Real income in the market, which is a weighted average for the United States, Canada, and Mexico, appears to have declined after 1973. This is probably caused by high inflation rates, which increased the composite consumer price index from 100 in 1970 to approximately 150 in 1976.

Charter traffic, which constitutes a major proportion of total traffic (more than 20 percent), is included in the traffic model for this market. The strong dependence of traffic demand on income in this market can be seen from the rather low constant-term value (exponent -16.7) and the rather high income elasticity (+3.57). Fare elasticity is also rather high, oscillating very close to -3.00 during the years of analysis.

A comparison of actual traffic trends with those produced by the traffic demand model seems to suggest that perhaps a time lag of one year is appropriate in the relation between income and traffic. This refinement is to be the subject of further study of this model.

The absence of wide choices in fare structure allowed the use of a specific fare rather than market yield as the price variable for this market. Unlike many other markets, the real yield did not decline during the 1970-1976 period. Many model calibrations in which yield was used as the price variable resulted in positive elasticities, and consequently a fare variable was used instead. The regular economy fare between New York and Mexico City was used as the representative fare in this market in order to analyze the historic trend of the price of travel. A price elasticity of approximately -3.00 was obtained for this market.

Europe-Northern Africa

In spite of what the name implies, the Europe-Northern Africa market does not include the countries of "North Africa" but covers traffic between Europe and countries south of Algeria, Morocco, and Tunisia and north of Angola, Mozambique, Zambia, and Tanzania. The two markets in this study that include Africa—this one and the Europe-Southern Africa market—suffer from lack of data on the African countries involved, with the exception of South Africa.

The income variable for this market is the weighted average for European countries only, as is the composite consumer price index. This is a deficiency caused by lack of data; if additional data on the African countries were obtained, it would be highly desirable to recalibrate the model. The fact that the model shows an exceptionally good statistical fit should not distract attention from the need to remedy the data situation (see Figure 6).

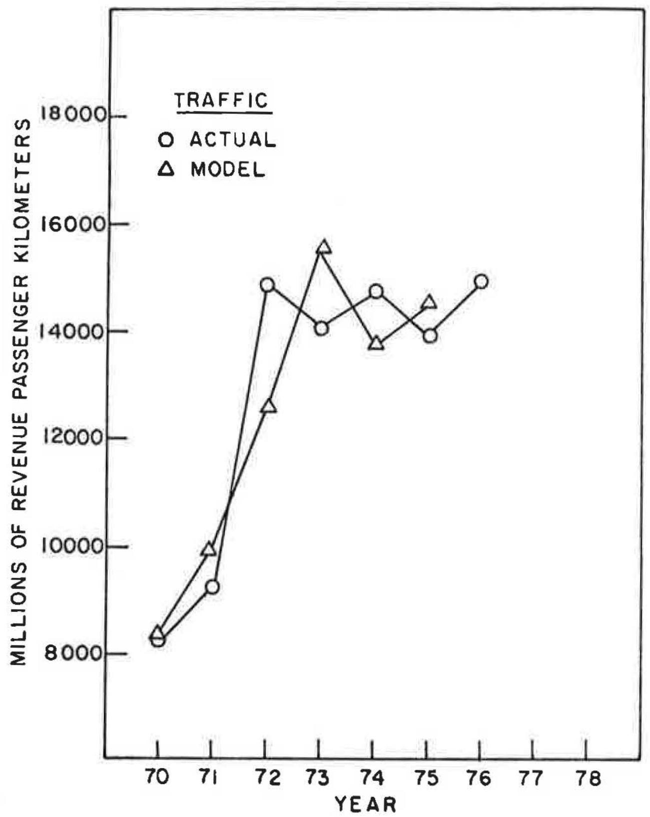
The Europe-Northern Africa market has experienced capacity growth, especially during the period after 1974. Between 1974 and 1976, total available capacity in seat kilometers increased from 6.8 billion to slightly more than 12.3 billion. During the same period, the traffic increased from 3.5 billion to about 7.5 billion revenue passenger-km, which indicates a consistently high market load factor. This leads to the suspicion that capacity may have been constraining traffic development and that it should be included as a demand variable in the model. Indeed, capacity turns out to be a significant demand variable in relation to which the demand appears to have an elasticity in the neighborhood of +1.0. If continued fleet and airline expansion in the market results in a faster increase in capacity than in traffic, it is likely that capacity will no longer be a determinant of traffic demand in that market. The development of this market should therefore be monitored to assess the need to modify the model for future application.

Ideally, one would wish to estimate a simultaneous demand and supply model in which demand is affected by capacity and capacity by demand. Such an estimation would require a more elaborate technique, such as indirect least squares. Further research into this question is in order, especially in light of the limited data available for model estimation. Simultaneous model estimation should ideally be used for all markets in which capacity appears to influence traffic development.

Income appears to be the only significant demand variable in the model for this market. This indicates that nonbusiness traffic may be predominant in this market or that the trend in per capita income is sufficiently strongly correlated with traffic that trade does not add any explanatory power to the model in a significant way.

A result of the introduction of capacity as a traffic-influencing factor is that income and yield explain less of the variations in traffic and this results in both of their elasticities being rather low. Income elasticity is constant at +0.4, and yield elasticity varies between -0.2 and -0.15—unexpectedly low values if the market is truly predominantly a nonbusiness travel market.

Figure 5. Comparison of actual and model traffic for North America-Central America market.



Europe-Southern Africa

The Europe-Southern Africa market is dominated by traffic between Europe and the country of South Africa. However, data availability limits the specification of variables to European countries. The model includes both trade and income as demand variables. This would be expected because the market includes almost equally important proportions of business and nonbusiness traffic.

The Europe-Southern Africa market is a medium-density market with an average traffic volume of 8.5 billion revenue passenger-km during the study period. It experienced strong growth between 1973 and 1976, during which time the volume increased from about 8.4 billion to 13 billion revenue passenger-km. The trends indicate that this strong growth in traffic is related to two factors: a decline in air fares (here represented by the London-Johannesburg economy fare) and a slowing of the growth of the inflation rate, which resulted in an increase in U.K. disposable income per capita. It is interesting that the increase in traffic occurred despite the decline in trade flows after 1974 (see Figure 7). It appears that nonbusiness traffic is taking a more important role in this market.

The absence of complex fare packages in the market prompted the use of a single representative fare rather than yield in the model. In addition to its simplicity, this appears to have advantages in relation to statistical significance. Another indication of the dominance of nonbusiness traffic could be the relative price elasticity of the traffic, which varies between -2.3 and -1.74 during the study period.

Figure 6. Comparison of actual and model traffic for Europe-Northern Africa market.

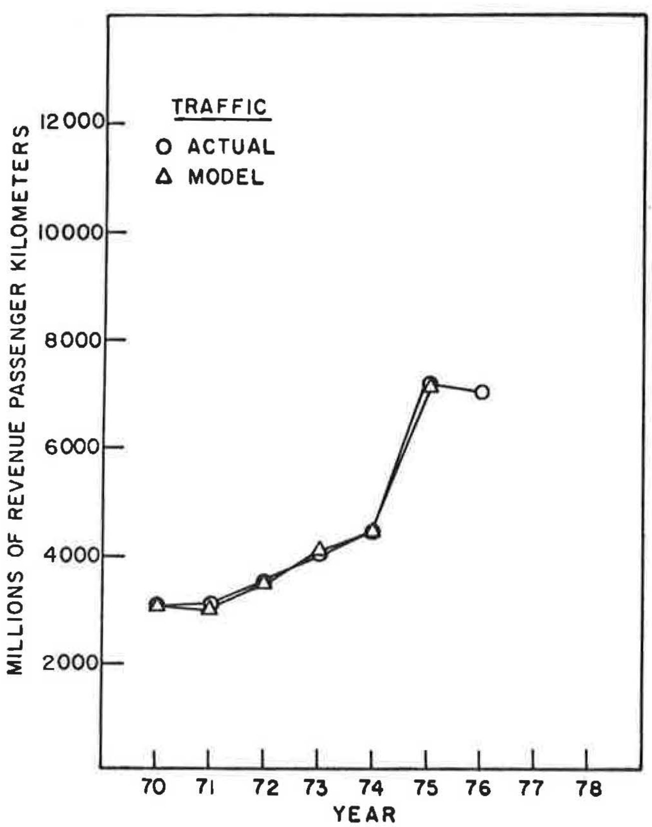


Figure 7. Comparison of actual and model traffic for Europe-Southern Africa market.

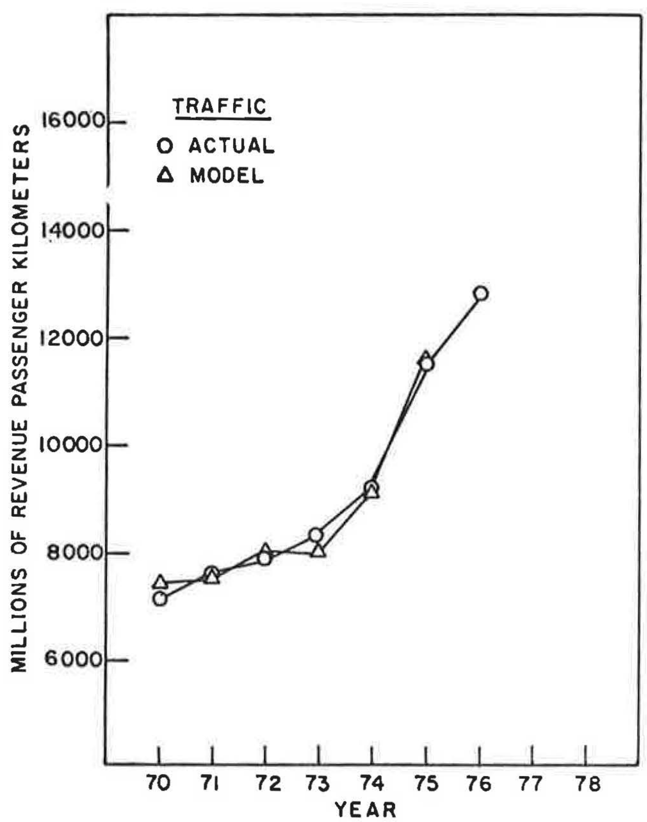
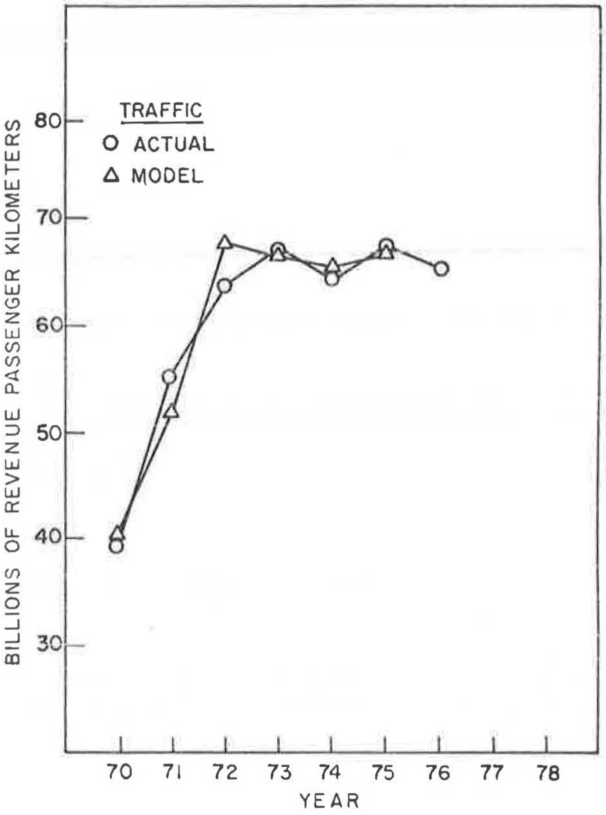


Figure 8. Comparison of actual and model traffic for local Europe market.



Local Europe

The local Europe market is unlike the other markets included in this study. It is a high-density, short-haul market in which traffic grew from 39 billion to 65 billion revenue passenger-km during the study period (see Figure 8). The market exhibits a relatively high load factor of about 60 percent, but capacity does not appear to be a constraint on traffic development and this variable is not included in the model. Local Europe is also a market of relatively high yield (about 9 cents/revenue passenger-km in 1976) and relatively high cost (about 5.2 cents/revenue passenger-km in 1976).

Charter traffic constitutes about 47 percent of the total traffic in the market. This percentage did not change appreciably during the study period. Consequently, the model does include charter traffic. It is implicitly assumed that the relative fares of scheduled and charter operations have not changed much during the study period (or else the charter share would have changed), and based on this assumption the model is constructed with a representative fare as the price variable. In the analysis, the fare variable always appeared more statistically significant than the yield variable. The representative fare used is the London-Rome economy fare.

The local Europe market serves both business and nonbusiness traffic. Both trade and income appear in the model as demand variables; traffic shows a higher elasticity for trade (+1.67) than for income (+0.84). Fare elasticity is about -0.8, which indicates a relatively inelastic demand. An interesting phenomenon in the market is the strong growth before 1972 and the relative stagnation after that. This trend appears to be the re-

Figure 9. Comparison of actual and model traffic for Europe-Far East/Australasia market.

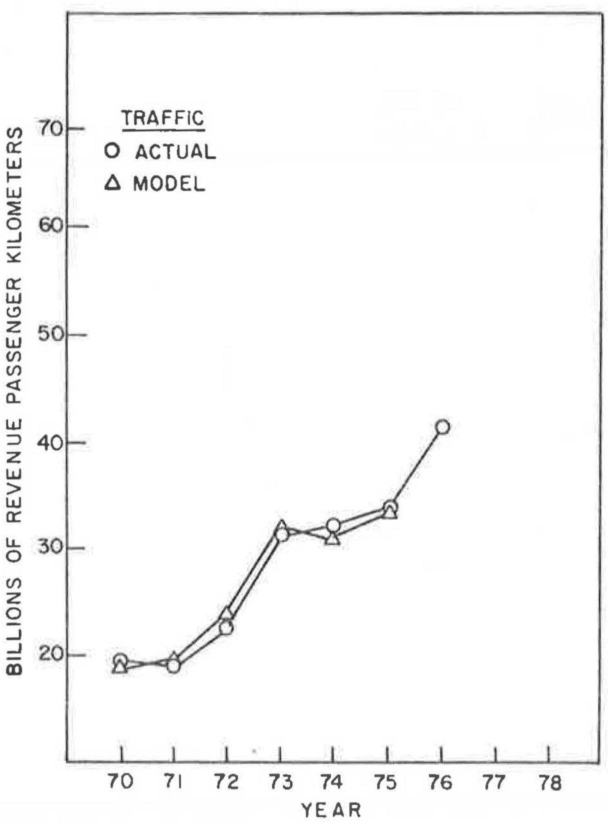


Figure 10. Comparison of actual and model traffic for South Pacific market.

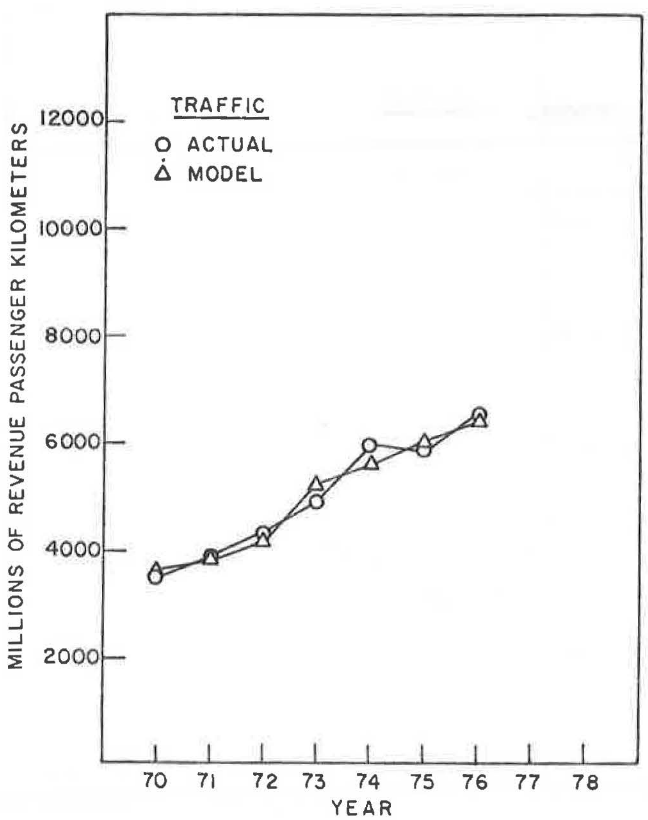


Figure 11. Comparison of actual and model traffic for North Pacific and Mid-Pacific market.

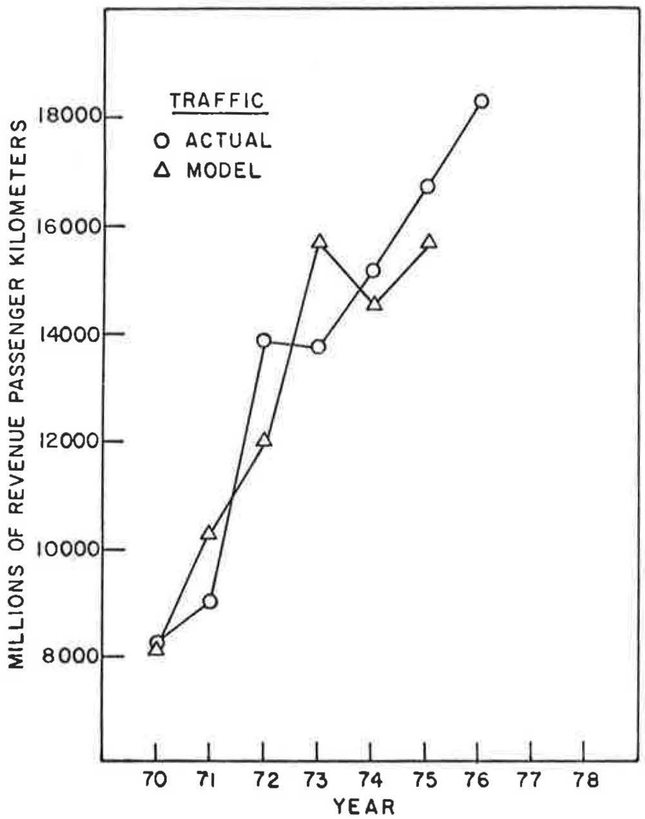
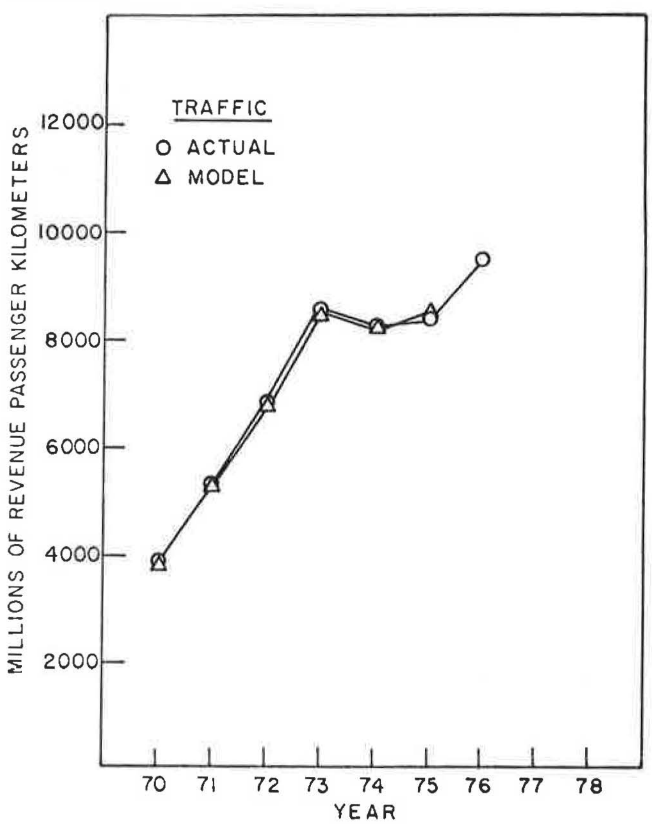


Figure 12. Comparison of actual and model traffic for local Far East/ Australasia market.



sult of a similar trend in trade combined with an increase in real price (as measured by fare) between 1971 and 1973. Weighted disposable income also shows a stagnation in real terms after 1973.

This is probably a market in which the data could permit a more detailed analysis of traffic demand. Country pair modeling is a possibility here. However, for the sake of consistency with the other analysis and with the integrated forecasting process, such an analysis was not attempted.

Europe-Far East/Australasia

The Europe-Far East/Australasia market is a long-haul market that connects two regions that are rather extensive in size and in number of countries. Traffic growth has been rather strong: from 14 billion to 39 billion revenue passenger-km during the 1970-1976 period (see Figure 9). The percentage share of charter traffic has consistently declined, from 22 to 7 percent, during the same period. Since the total traffic trend appears to be rather close to the trend for weighted per capita income, income is used as the demand variable in the model.

This market appears to be dominated by traffic between the United Kingdom and India and Australia and vacation traffic generated in Japan. Trade does not appear to be statistically significant and is not included in the model.

Despite the rather low charter share in recent years, the traffic model includes charter traffic. In using this model for forecasting, assumptions have to be made about charter share in computing passenger revenues and other related performance measures. Inflation is high in this market, and as a result real income growth is low and real yield declines considerably during the study period. This is perhaps another indication that, in order to successfully forecast traffic, a good prediction of the inflation rate is essential.

South Pacific

The South Pacific market is a relatively low-density market that had an average traffic volume of only about 5 billion revenue passenger-km during the study period. Growth has, however, been steady: Traffic increased from 3.5 billion revenue passenger-km in 1970 to about 6.6 billion revenue passenger-km in 1976 (see Figure 10). Although this market includes the South Pacific islands, which are typically tourist attractions, business traffic appears to dominate the market. It can be seen from the historic trends for this market that traffic volumes follow a pattern very similar to that followed by total trade between the countries of the market (here taken as the United States, Canada, the western hemisphere, and Australia and New Zealand). Attempts to include a nonbusiness demand variable such as income in the model did not prove successful. However, the model, with trade and yield as the only variables, is highly significant statistically and appears to be adequate for short-term forecasting. It would be desirable to recalibrate the model by using additional traffic data to see whether income would enter significantly as a nonbusiness traffic demand variable.

The South Pacific market exhibits relatively high inflation, as indicated by the large composite consumer price index. Consequently, real yield declines appreciably during the study period, and real trade does not show much growth. The decline in real yield results in a decline in yield elasticity, as would be expected from the form of the model. But the magnitude of elasticity is rather high, around -1.50, for a market with a good proportion of business traffic. This is probably attributable to the fact that the decline in real yield is taken as a reason for the strong growth in traffic, since real trade does not grow appreciably in real terms. Another reason is that this is a market with a very large stage length. Fare levels are rather high, and one would expect demand to be relatively elastic.

Charter traffic in the South Pacific market makes up an insignificant proportion of the total traffic—5 percent during the 1970-1976 period. For this reason, charter traffic is not included in the model.

North Pacific and Mid-Pacific

The traffic demand model for the North Pacific and Mid-Pacific market (see Figure 11) has been rather difficult to calibrate. The traffic level is generally rather low but underwent strong growth between 1970 and 1976, rising from 8 billion to more than 18 billion revenue passenger-km. Traffic in 1972 appears to be unexpectedly high, equaling the value in 1973. This cannot be explained by the trends of any of the socioeconomic variables used in the analysis. Indeed, what appears as a decline in traffic in 1973 is associated with a growth in real income. Real yield increased in 1972, as did traffic. All of this leads one to suspect a data problem, but there is no means of checking such a suspicion.

The share of charter traffic in the market steadily increased during the study period, rising from 4.5 percent in 1970 to 22 percent in 1974 and then dropping back to 14 percent in 1976. Charter traffic is therefore included in the demand model, and an assumption must be made in the forecasting process about the future charter share.

With traffic in this market dominated by the United States, Canada, and Japan, the variables for these three countries were used to derive the composite values for the model. Income appears to be the only significant demand variable and fare rather than yield to be significant as the price variable. Income elasticity is +4.8, and fare elasticity varies between -2.5 and -1.7 during the 1970-1976 period. Both of these values are considered too large. The absence of trade in a market believed to contain a significant proportion of business traffic is another source of concern about the model for this market. All in all, it would appear that some additional work on this market may be in order.

Local Far East/Australasia

The local Far East/Australasia market covers a larger area than its name might imply: all the area from India eastward to Japan and southeastward, including Australia and New Zealand. Any analysis of this market is then, by necessity, very aggregate. It is a relatively low-density market: Passenger traffic amounts to approximately 8.5 billion revenue passenger-km which, considering the medium stage lengths, is rather low (see Figure 12).

The market has relatively high load factors; load factors varied from 57 percent in 1970 to 60 percent in 1976. This indicates that capacity may be a constraint on traffic development. Indeed, the analysis indicates capacity to be a significant variable in the demand model, with an elasticity of +0.8. The other demand variable in the model is weighted per capita disposable income, which indicates that nonbusiness traffic may predominate. Income elasticity is low at +0.62, which probably results from the fact that capacity has explained a good part of traffic development. The traffic trend, which shows a period of stagnation between 1974 and 1976, is very similar to the trend for income. Inflation rates in the market are rather high: The composite consumer price index rises from 100 to 200 during the study period.

Note that the income variable in this case is not a weighted composite but that of Japan alone. Since a sizable proportion of the traffic is vacation traffic generated in Japan, this is not too restrictive.

Price is represented by the Tokyo-Bangkok economy fare. This was found to be appropriate because this market does not have any significant choices in terms of fares or any charter operations to speak of. Again, capacity increases seem to explain a significant proportion of the traffic development, and fare elasticity appears to be low—in the -0.29 to -0.27 range. Fares have almost doubled during the study period, but the high inflation rates result in a decline in real fares.

SUMMARY

The results of the calibration of traffic demand models for 12 of the 13 study markets appear to be generally good. In fact, given the nature of the data base and the vastly varied conditions that exist in the various world travel markets, the results are surprisingly good. With the exception of the North Pacific and Mid-Pacific market and the North America-Central America market, all models appear to be statistically significant and to exhibit good fits with historic trends. It is interesting that model structures and, to a certain extent, parameter values are quite similar. For example, most yield elasticities fall within less than 1.0 of one another; fare elasticities vary by slightly more.

It would seem that, although further work on traffic demand modeling in these international travel markets is certainly warranted, use of the current models in short-term forecasting is feasible. The good statistical results obtained by using these models show rather low standard error values and permit forecasting with confidence.

More work should be done on the Europe-Middle East market, but such work is feasible only if additional data are obtained. Both socioeconomic variables and carrier data appear to be lacking for this market, and it is a market that must be modeled with particular care because of the significant changes in traffic that have occurred in recent years. Two other markets need further work: the North Pacific and Mid-Pacific and the North America-Central America markets. With additional socioeconomic data, particularly for the North Pacific and Mid-Pacific markets, it might be possible to successfully calibrate a traffic demand model. These two markets have been integrated in the forecasting process, but their results should be looked at with more skepticism than those for the other markets.

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