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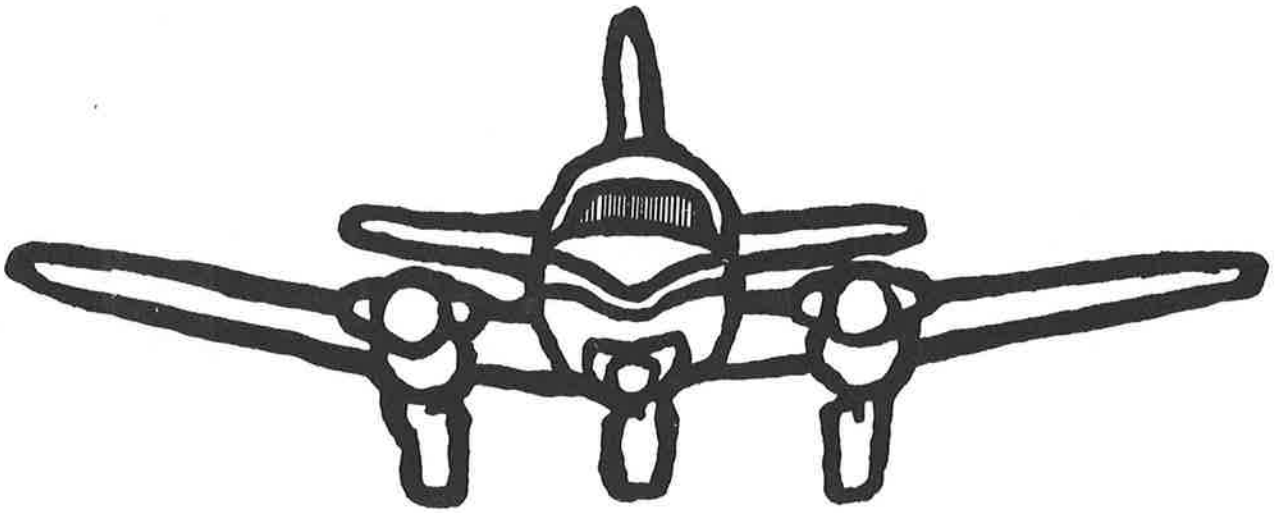
National and Selected Hub Forecasts

November 1979



U.S. Department of Transportation
Federal Aviation Administration
Office of Aviation Policy
Aviation Forecast Branch
Washington, D.C. 20591

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November 1979
Final Report

U.S. DEPARTMENT OF TRANSPORTATION
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Transportation Systems Center
Cambridge, MA 02142

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16. Abstract

This report presents new TSC domestic and international air cargo models developed in FY79 and alternative forecasts for domestic and international air cargo activity from 1979 to 1991.

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PREFACE

This report was prepared under Contract No. PPA FA-950, Models and Forecasts for Domestic International Air Cargo Activity, sponsored by the Federal Aviation Administration, Office of Aviation Policy (AVP-120).

All forecasting models for air cargo activity have been estimated with alternative functional forms. A corrected functional form is chosen based on the Box-Cox transformation technique and our prior knowledge about the future possible behavior of air cargo traffic.

The forecasting model for international air cargo activity includes 24 regression equations. These equations have been estimated with time series data from 1964 to 1977. In comparison with previous TSC models, the major improvement of this revised model is the construction of price proxy variables for each of the six world regions. Regression results indicate that most co-efficients of the revised price proxy variable have the expected signs and are statistically significant.

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1. INTRODUCTION

This study accomplished three main purposes. First, econometric models for domestic and international air activity, both freight and express (excluding mail), were empirically constructed and estimated. Second, annual forecasts from 1979 to 1991 were generated from these estimated models. Third, aggregate domestic and international air cargo activity forecasts were disaggregate into air cargo activity forecasts at selected major air hubs. Throughout this report, the term "air cargo" refers to both air freight and express services, excluding mail.

A common practice in previous empirical studies of air cargo demand has been to choose between linear forms and log-linear forms. In this study, the Box-Cox transformation technique was adopted to provide guidelines for choosing alternative functional forms for air cargo demand. (The linear form and log-linear form were the special cases of this class of transformation. The levels of long-run forecasts critically depended upon the functional form chosen by the model builders.)

The new TSC air cargo econometric model consists of two major sub-models: (1) the domestic air cargo model, and (2) the international air cargo model.

*This report is the joint work of three authors and the name are arranged alphabetically. Mark Hollyer is the author of Section 4. Walt Maling is the author of Section 3.5 to 3.7 and George Wang is the author of Section 2 and 3.1 to 3.4.

The domestic air cargo (freight plus express) activity is composed of three components: the passenger/cargo carrier model, all services; all-cargo carriers, scheduled services; and all-cargo carriers, non-scheduled services.

The international air cargo model consists of six world regional models. These six world regions are: North America excluding U.S., South America, Europe, Asia, Australia and Oceania, and Africa. For each world region, export (outbound) and import (inbound) equations for U.S. flag carriers and total carriers are constructed and estimated. There are twenty-four regression equations in the international air cargo model.

Alternative annual forecasts from 1979 to 1991 were generated from the new TSC air cargo model with alternative scenarios of future values of Gross National Product (GNP) in 1972 dollars and real yield per revenue ton-miles. A top-down approach was employed to produce forecasts of domestic air cargo activity for each of the top 38 major air hubs, and forecasts of international air cargo activity for each of the 28 major air hubs. These forecasts not only provide valuable information for FAA budget requests and policy plan development, but also information required by local and regional planners for hub airport facility planning.

This study is organized into five sections. Section 2 discusses the concept of empirical models and econometric techniques used in the study. Section 3 present the domestic air cargo models and forecasts. The international air cargo models and forecasts are presented in Section 4. The major results of this study are summarized in Section 5.

2. SOME CONSIDERATIONS IN ECONOMETRIC TECHNIQUES

Before presenting the empirical models it is useful to discuss the concept of an empirical model and the choice of functional forms and estimation techniques used in this study.

It is a difficult task to build and select alternative models based on non-experimental data (i.e., observed data). This is because the variable of interest (the dependent variable) is influenced by many variables and/or interactions of these variables. Hence, ideally a very complicated model with a large set of parameters is desired. However, the following factors limit the building of such a model: the limited length of sample data, the availability of data for independent variables, and the increasing unreliability of the parameters as the number of parameters increase in the model. Hence, all models are wrong in the sense of not fully incorporating all variables found in reality (3). However, an empirical model is considered adequate if it can successfully serve the purpose for which it was intended.

In this case, an empirical model is considered a mathematical formulation which serves two purposes:

(1) to provide a partial prediction of the various outputs Y_t from various values of the input variables X_t's in the presence of unknown disturbance in the post-sample period.

(2) to aid in a better understanding of the nature of the mechanism generating this process.

Symbolically, the empirical model is stated as:

$$Y_t = f\ (X_t\text{'s}\ |\beta) + U_t$$
$$\text{and } U_t = \frac{1}{\rho(B)}\ e_t \qquad (2.1)$$
$$\rho(B) = (1-\rho_1 B - \rho_2 B^2, ---, \rho_p B\ )$$

and B is a backward shift operator.

The part $f\ (X_t\text{'s}\ |\beta)$ is a predictable component, which contains the observed values of the X's and the associated unknown parameters. U_t is considered as a catch-all variable which can be represented by a stationary parametric time series model such as a p^{th} order autoregessive process $U_t = \frac{1}{\rho(B)}\ e_t$. The notation e_t represents a sequence of independent normal random variables with zero mean and constant variance $\sigma^2_{e_t}$.

In estimating empirical models, such as (2.1), economists must choose a functional form to describe the relationships among the variables of interest. Usually, knowledge of economic theory and the air cargo industry only provides information about signs of the variables and the variables to be included in the model. Often this knowledge fails to suggest a functional form. For this reason, a common practice in the econometric study of air freight demand is to choose between linear forms and logarithmic forms [see (19), (12)].

However, there is no theoretical reason to restrict selection to only those two functional forms. Further, it is sometimes difficult to discriminate between these two functional forms using conventional measures alone (such as R^2 and significance of t statistics). Therefore, the choice of functional form is left to the discretion of the model builder.

The Box-Cox transformation procedure (2) is a statistical technique that can be used to provide guidelines for choosing alternative functional forms. The Box-Cox transformation technique was used by Zarembka (20), and White (19) to test the functional form for the demand of money. Zarembka (21) also applied this technique to study the demand for food in developing countries. Further, Gaudry and Wills (10) employed this technique to estimate the functional form of travel demand models. As far as could be determined, there does not seem to be any previous study which has applied this technique to choose among functional forms for air freight demand. The levels of long-run forecasts critically depended on the functional form chosen by the economist.

The procedure of choosing a generalized functional form by the Box-Cox transformation technique is briefly illustrated by the following example. Consider, a generalized functional form of a demand function such as:

$$Y_t^{(\lambda)} = \beta_0 + \beta_1 X_{1t}^{(\lambda)} + \beta_2 X_{2t}^{(\lambda)} + \beta_3 X_{3t}^{(\lambda)} + e_t \qquad (2.2)$$

where

Y_t is the quantity demanded at time t;

X_{it} is the explanatory variables at time t, i = 1, 2, 3;

and

e_t is an error term.

The Box-Cox transformation is:

$$Y_t^{(\lambda)} = \begin{cases} \dfrac{Y_t^{\lambda}-1}{\lambda} & \text{when } \lambda \neq 0 \\ \ln Y_t & \lambda = 0 \end{cases}$$

$$X_{it}^{(\lambda)} = \begin{cases} \dfrac{X_{it}^{\lambda}-1}{\lambda} & \text{when } \lambda \neq 0 \\ \ln X_{it} & \lambda = 0 \end{cases} \qquad i = 1,2,3. \tag{2.3}$$

Clearly, when $\lambda = 1$, equation (2.2) becomes linear and when $\lambda = 0$, the equation becomes linear in the logarithmic form. From equation (2.2), it is also apparent the different values of λ lead to different functional forms.

The Box-Cox transformation technique defined in equation (2.2) was used to estimte the value of λ and the other equation parameters from sample data. An iterative search was performed over the set of functional forms defined by equation (2.2) to determine the "best" description of the relationship among the variables.

For computation, maximum likelihood estimation was used to estimate λ and the other parameters, under the assumption that e_t

is normally and independently distributed. The concentrated likelihood function for (2.2) was found to be:

$$L_{max}(\lambda) = \frac{n}{2} \log \hat{\sigma}^2_{(\lambda)} + (\lambda-1) \sum_t \ln Y_t \qquad (2.4)$$

where $\hat{\sigma}^2(\lambda)$ is the estimated error variance of the regression of $Y_t(\lambda)$ on $X_{1t}(\lambda)$ and $X_{2t}^{(\lambda)}$.

The optimal λ was chosen to maximize equation (2.4). Box-Cox (2) also suggested that the confidence level $(1-\alpha)$ for λ based on the result of $2[L_{max}(\hat{\lambda}) - L_{max}(\lambda)]$ was distributed as Chi-square with one-degree of freedom.

In summary, the merits of the Box-Cox transformation are as follows:

(1) the transformation obtained is the result of estimation, not prior specification,

(2) the technique allows the data to "select" a functional form from among those defined by (2.2). The linear and log form are special cases of this class of transformation. Thus, the estimated functional form is empirically determined as a maximization on the data set;

and (3) the estimation procedure itself provides a test procedure to compare alternative functional forms rather than to accept a particular functional form as a maintained hypothesis.

Finally, some limitation in the application of this technique should be mentioned: (1) the Box-Cox techniques fails as guide to selection of alternative functional forms if the likelihood function of (λ) is very flat. However, in this study, we did not meet this situation, and (2) the distribution properties of this test were derived from large sample theory.

In the case when Durbin-Watson statistics of the model (2.2) chosen by λ is low, the extension of the current model into two enlarged models was considered: (1) generalized functional forms with autocorrelated errors, and (2) generalized functional forms of partial adjustment model with independent errors.

3. DOMESIC AIR CARGO FORECASTS

3.1 Historical Movements

The domestic air industry consists of two categories: passenger/cargo carriers and all-cargo carriers. The group of passenger/cargo carriers is composed of domestic trunk carriers, local service carriers, helicopter carriers, intra-Alaska carriers, and intra-Hawaii carriers. The all-cargo carriers are restricted to freight in their scheduled and non-scheduled operations, although they may carry passengers under charter. There are currently three domestic all-cargo carriers: Flying Tiger Lines, Airlift International, and Seaboard.[1]

Table 3.1.1 presents the historical growth rates of domestic air freight traffic. Over the entire sample period, the overall average annual growth rate was 10.1 percent for total domestic traffic (freight plus express), 10.1 percent for passenger/cargo carrier operations and 7.2 percent for all-cargo carrier operations.

The five-year interval growth rates of the total and its components indicate a consistent pattern. They had an upward swing from 1950 to 1965 and then slipped downward gradually after 1965.

The average annual growth rate from 1961 to 1965 was the highest among the sub-periods of this total time frame. Many factors caused this apparently abnormal growth rate in this five-year period.

1/ Prior to 1976, the all cargo carrier data did not include Seaboard.

TABLE 3.1.1

THE HISTORICAL GROWTH RATES OF
TOTAL DOMESTIC AIR CARGO TRAFFIC,
ALL SERVICES
1950 -- 1977

Year	Total (1) + (2)	Passenger/Cargo Carriers (1)	All Cargo Carriers (2)
1950--1955	8.4	8.8	7.5
1955--1960	11.39	10.5	16.8
1960--1965	19.74	20.7	14.9
1965--1970	9.7	15.0	- 8.1
1970--1975	4.0	3.2	8.8
1975--1977	4.4	4.7	2.7
1950--1977	10.1	10.1	7.2

For example, some of these factors were: the swift conversion of the civil air fleet to jet aircraft with higher productivity and lower average operating costs; the great increase of volume and lift capacity in the heavy trunk routes and the availability of air cargo lift capability at more airports; and, a reduction in real price differential between air and surface modes.

Table 3.1.2 presents historical traffic share of passenger/cargo carriers and all-cargo carriers in the period from 1950 to 1977. It is clear that passenger/cargo carriers dominate the traffic share with 69.7 percent of total domestic traffic in 1955, 87.3 percent in 1970 and 84.5 percent in 1977.

The relative importance of scheduled services and non-scheduled services in all-cargo carrier operations over this sample period is shown in Table 3.1.3.

From 1960 to 1965, all-cargo carriers' non-scheduled services accounted for 60 percent of the total all-cargo carriers traffic. However, this situation is reversed after the 1970's. The share of non-scheduled services only accounted in the range of 15.2 percent to 4 percent of total all air cargo carrier operations. Further, the traffic of non-scheduled services fluctuated widely compared with those of scheduled service. This many indicate that the random component of the non-scheduled services often dominates the systemic component of the series. On the other hand, the scheduled services accounted for at least 80 percent of the total air cargo carrier traffic since 1970.

TABLE 3.1.2

THE TRAFFIC SHARES OF PASSENGER/CARGO CARRIERS AND ALL-CARGO CARRIERS IN TOTAL DOMESTIC AIR TRAFFIC ALL SERVICES, 1950-1977

Year	Passenger/Cargo Carriers	All-Cargo Carriers
1950	68.43	31.57
1955	69.79	30.20
1960	63.66	36.34
1965	69.16	30.84
1970	87.27	12.73
1975	83.98	16.02
1977	84.50	15.50

TABLE 3.1.3

THE SHARES OF SCHEDULED AND NON-SCHEDULED SERVICES IN DOMESTIC ALL-CARGO CARRIER TRAFFIC 1950-1977

Year	Scheduled Service	Non-Scheduled Service
1951	74.28	25.72
1955	86.80	13.20
1960	39.83	60.17
1965	37.43	62.58
1966	38.26	61.74
1967	36.12	63.88
1968	51.26	48.74
1969	52.79	47.21
1970	84.84	15.16
1971	87.70	12.30
1972	87.98	12.02
1973	92.65	7.35
1974	91.77	8.23
1975	93.14	6.86
1976	96.02	3.98
1977	89.01	10.99

3.2 The Models

In general, the demand for air freight is a function of general economic activity, air freight rates, and the quality of air freight service. The quality of freight service includes: schedule frequency, the speed, capacity, reliability of delivery time, and probability of loss and damage. Unfortunately, there is not a comprehensive and consistent set of data available on these measures of the quality of freight service for this sample period. Thus, these variables are not included in the model.

Among freight transportation modes, motor carriers are, in general, considered to be the competing mode for the air freight mode in the segment of freight market for high value and high density commodities over the short-haul distance. At short-distances, the speed advantage of air freight would be nullified and thus all traffic would be sensitive to the competitive rates of motor freight.

Based on the considerations discussed above, the initital statistical model for the aggregate demand for domestic air freight traffic is postulated as follows:

$$Y_t^{(\lambda)} = \beta_0 + \beta_1 X_{1t}^{(\lambda)} + \beta_2 X_{2t}^{(\lambda)} + \beta_3 X_{5t}^{(\lambda)} + e_t \qquad (3.2.1)$$

Where

Y_t = Total domestic revenue ton-miles (freight plus express), all services

X_{1t} = GNP in 1972 dollars

X_{2t} = Real yield per revenue ton-mile of total domestic air freight traffic (freight plus express)

X_{5t} = Real yield per ton-mile of Class I motor carriers

and e_t, an error term, is assumed to be distributed as an independent normal random variable with zero mean and constant variance. The transformation of $Y_t(\lambda)$ and $X_{it}(\lambda)$ are defied in (2.3).

The a priori restrictions of the signs of these parameters are:

$$\beta_1 > 0, \quad (2)\ \beta_2 < 0 \text{ and } (3)\ \beta_3 > 0.$$

The bulk of cargo capacity offered by the passenger/cargo carriers is in the lower holds of passenger flights. These flights are basically passenger service and follow route patterns and schedules which are optimized to meet the needs of passenger travel patterns. The route pattern and schedule which are suitable for passenger travel do not necessarily meet the needs of freight shippers. For example, shippers of freight tend to make up shipments during the day and release them to carriers in the late afternoon and evening for carriage that night. On the other hand, the schedules of passenger flights are heavily concentrated during the day. All-cargo carriers, in general, are more flexible in meeting the route pattern and schedule demanded by freight shippers. Therefore, the freight services offered by these two

groups is non-homogeneous in terms of route patterns, schedules and capacity offered by aircraft. Thus, disaggregate demand models for these two groups are constructed and estimated separately in order to capture these differences.

The initial statistical models for passenger/cargo carriers and all-cargo carriers developed are:

$$Y_{1t}^{(\lambda)} = \alpha_0 + \alpha_1 X_{1t}^{(\lambda)} + \alpha_2 X_{3t}^{(\lambda)} + \alpha_3 X_{5t}^{(\lambda)} + e_{1t}$$
$$Y_{2t}^{(\lambda)} = \delta_0 + \delta_1 X_{1t}^{(\lambda)} + \delta_2 X_{4t}^{(\lambda)} + \delta_3 X_{5t}^{(\lambda)} + e_{2t} \qquad (3.2.2)$$

Where:

Y_{1t} = cargo (freight plus express) revenue ton-mile of passenger/cargo carriers, all services

Y_{2t} = cargo (freight plus express) revenue ton-mile of all cargo carriers, scheduled services

X_{3t} = the real yield per revenue ton-mile of passenger/cargo carriers, all services

X_{4t} = the real yield per revenue ton-mile of all-cargo carriers, scheduled services

and X_{1t}, X_{5t} are defined in equation (3.2.1) and e_{1t} and e_{2t} are error terms, which are assumed to be distributed as $e_{1t} \sim NID(0, \sigma^2_{e_1})$, and $e_{2t} \sim NID(o\sigma^2_{e2})$ respectively.

Finally, it is worth mentioning that the construction of a disaggregate model permits us to model a different behavior for each series in terms of its differences in parameter values as well as in functional form.

3.3 The Data

Annual time series data covering the period from 1950 to 1977 were used in the study. The various measures of the variables and data sources are discussed in this section.

Domestic air cargo operations (Y_t) for all services on certificated routes are measured in terms of millions of revenue ton-miles. The data from 1950 to 1977 are available from the Handbook of Airline Statistics (1974), supplements to the Handbook of Airline Statistics and various issues of Air Traffic Statistics.

The component measures, Y_{1t} and Y_{2t}, are derived from the same sources as Y_t.

X_{1t} denotes annual data for gross national product (GNP) measured in 1972 dollars. It is available from various issues of Survey of Current Business.

X_{2t} represents the current yield per revenue ton-mile of total domestic operations (freight plus express), deflated by GNP implicit price deflator (1972 = 100). Annual data for the total revenue of domestic operations, all service is available from Handbook of Airline Statistics and various issue of Air Carrier Financial Statistics. The annual index of GNP implicit price deflator (1972 = 100) is available from Survey of Current Business. The other yield variables, X_{3t} and X_{4t} are obtained from the same sources as X_{2t}.

X_{5t} stands for current yield per ton-mile of Class 1 motor carriers, deflated by the GNP implicit price deflator (1972 = 100). Current revenue per ton-mile was obtained from various issues of Transport Economics published by the Bureau of Economics, Interstate Commerce Commission. It should be mentioned that this variable is used as a proxy for the price index per revenue ton-mile of Class 1 motor carriers because the data of current yield per revenue ton-mile was not available at the time when this study was undertaken.

3.4 The Empirical Results

In this section estimated aggregate and disaggregate demand models for domestic air cargo traffic are presented. In estimating the parameters of the models, each variable was first transformed, following the defiition of $Y_t(\lambda)$ and $X_{it}(\lambda)$ in (2.3). The value of λ is specified in the range of [-1.6, 1.6] with increment intervals of 0.2. Then the least square estimation is performed on each set of transformed variables. L_λ -max was calculated for each regression by using equation (2.4). The estimated model chosen is the one which maximizes the log likelihood function of λ.

Annual time series data from 1950 to 1977 were first used to estimate the aggregate demand function and the regression result associated with differenet values of λ are reported in Table 3.4.1. The plot of the log likelihood function of λ is shown in Figure 3.4.1. The optimal value of λ is 0.6 with a 95 percent confidence level of λ within the [0.35, 0.7]. This indicates that both the linear functional form hypothesis and the log functional form hypothesis are rejected at the 1 percent level in this sample period. Further, Table 3.4.1 provides us with points of interesting empirical evidence: (1) one of the causes of auto-correlation is an incorrect specification of the functional forms of the relationships among variables, and (2) the incorrect functional form may lead us to include the variables that should not by included and vice versa.

TABLE 3.4.1

THE REGRESSION RESULTS AND RELATED STATISTICS OF EQUATION (3.4.1)

*** BOTH SIDES OF THE EQUATION ARE TRANSFORMED ***

LAMBDA	L-MAX	R02/F	D-W	INTERCEPT	COEFF. OF X2	COEFF. OF X3	COEFF. OF X4	C
		0.9856 617.91	1.056	1651.365385 (1.235)	2.811629 (6.389)	-50.473667 (-2.586)	-148.257450 (-1.351)	
1.60	-154.946	0.9660 257.08	0.568	-7554.097535 (-0.072)	5.073684 (5.884)	94.475205 (0.328)	-4728.474088 (-1.146)	
1.40	-149.514	0.9719 311.77	0.642	7690.205881 (0.313)	4.116052 (5.691)	-49.502342 (-0.405)	-1641.470195 (-1.279)	
1.20	-143.121	0.9787 414.62	0.787	4153.229070 (0.738)	3.356440 (5.784)	-67.167980 (-1.343)	-527.979550 (-1.374)	
1.00	-135.491	0.9856 617.91	1.056	1454.445897 (1.167)	2.811629 (6.389)	-50.473667 (-2.586)	-148.257450 (-1.351)	
0.80	-126.946	0.9912 1010.60	1.503	391.367069 (1.443)	2.492382 (7.825)	-30.833013 (-4.210)	-30.564182 (-1.010)	
0.60	-120.692	0.9938 1445.62	1.845	68.384090 (1.043)	2.395058 (9.715)	-16.537572 (-5.593)	-0.094868 (-0.010)	
0.40	-122.594	0.9925 1192.65	1.378	-7.948746 (-0.360)	2.498263 (9.929)	-7.951309 (-5.028)	4.676547 (1.286)	
0.20	-129.938	0.9871 690.89	0.839	-17.878889 (-1.859)	2.766860 (8.990)	-3.405805 (-3.349)	3.556230 (1.999)	
0.00	-137.452	0.9785 410.82	0.619	-14.578420 (-3.136)	3.161149 (8.441)	-1.243373 (-1.907)	1.976608 (2.248)	
-0.20	-143.913	0.9681 274.42	0.556	-10.677780 (-4.313)	3.646199 (8.385)	-0.322984 (-0.809)	0.957220 (2.278)	
-0.40	-149.485	0.9575 203.85	0.553	-8.101220 (-5.435)	4.197570 (8.640)	0.014180 (0.060)	0.427730 (2.190)	
-0.60	-154.502	0.9478 164.46	0.571	-6.599272 (-6.479)	4.802753 (9.071)	0.105231 (0.776)	0.181168 (2.031)	
-0.80	-159.244	0.9396 141.01	0.597	-5.749259 (-7.420)	5.459800 (9.585)	0.106112 (1.377)	0.073820 (1.826)	
-1.00	-163.918	0.9330 126.24	0.623	-5.273907 (-8.252)	6.174964 (10.120)	0.081975 (1.881)	0.029185 (1.596)	
-1.20	-168.669	0.9276 116.36	0.646	-5.020644 (-8.980)	6.960525 (10.633)	0.056641 (2.295)	0.011247 (1.355)	
-1.40	-173.582	0.9233 109.31	0.663	-4.909495 (-9.609)	7.833283 (11.092)	0.036852 (2.625)	0.004232 (1.116)	
-1.60	-178.702	0.9196 103.92	0.675	-4.898825 (-10.144)	8.813764 (11.483)	0.023118 (2.874)	0.001553 (0.891)	

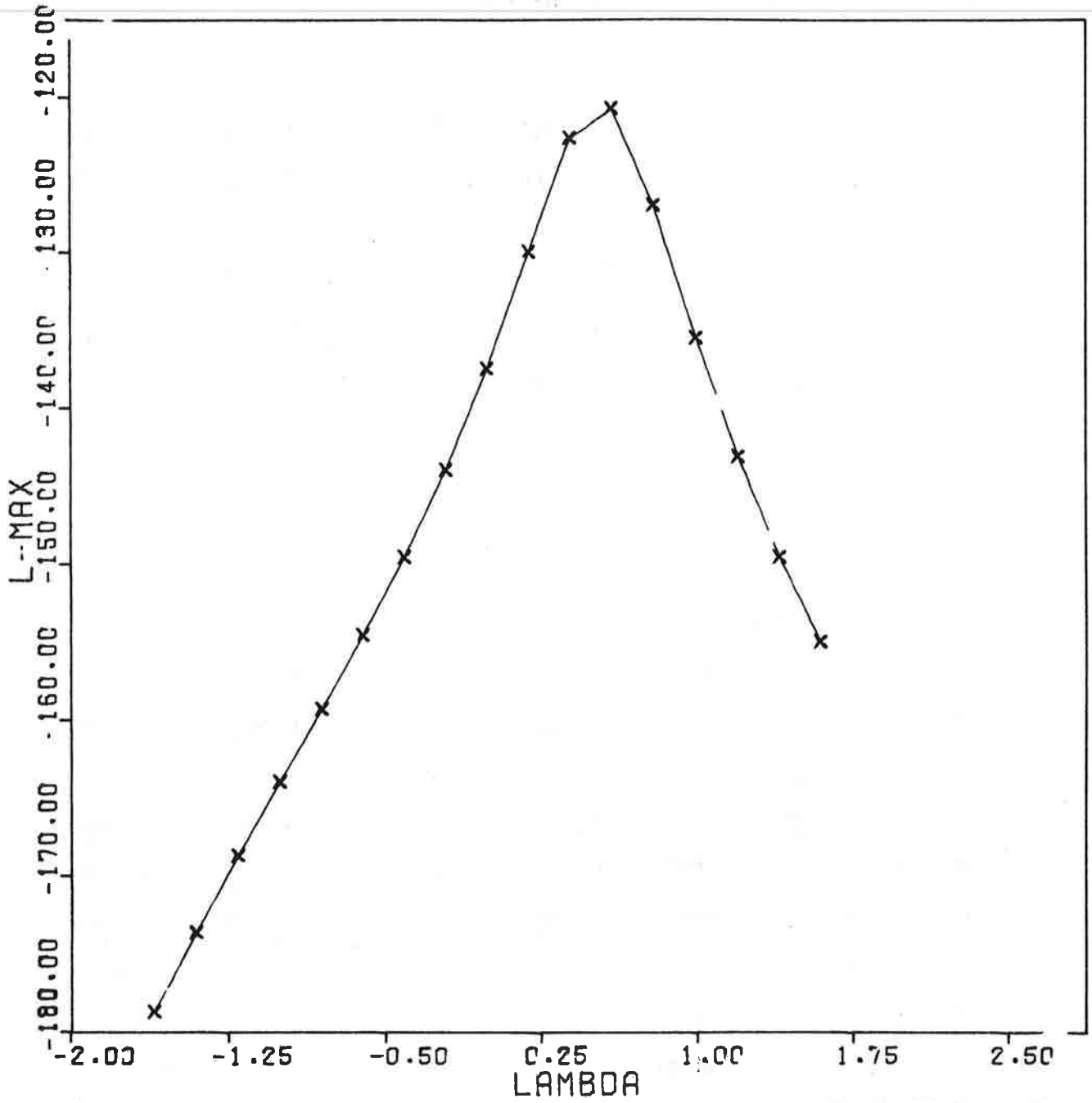


FIGURE 3.4.1 THE PLOT OF THE VALUES OF LIKELIHOOD FUNCTIONS FOR EQUATION 3.4.1 WITH VARIOUS VALUES OF λ'S

In the appropriate model with $\lambda = 0.6$, the variables of GNP in 1972 dollars and real air freight rates are statistically significant at the 1 percent level. The coefficient of motor freight price is statistically insignificant and possesses inconsistent signs.

It is possible that the functional form of the model may change over time. To test this hypothesis, the model was estimated again with the data from 1955 to 1977 and 1962 to 1977, respectively. The empirical results reported in Table 3.4.2 suggest that the functional form is relatively stable in this period. Again the motor freight price is not statistically significant and possesses inconsistent signs in the model estimated with these two sub-time periods.

For these reasons, the motor carrier price is deleted from this model and re-estimated with data from 1962 to 1977. Again, the optimal value of λ is 0.6 for this revised model. The empirical results suggest that the functional form is relatively stable in this period.

The empirical results of passenger/cargo carrier models are presented in Table 3.4.3. It is interesting to observe that the coefficient of motor freight price is positive and statistically significant at the 5 percent level in the time period from 1950 to 1977. However, the t statistic of this variable becomes 1.38 in the model from 1955 to 1977, and decreases to 1.12 in the model from 1960 to 1977. There are two possible explanations of this phenomenon.

TABLE 3.4.2

REGRESSION RESULTS OF AGGREGATE DOMESTIC AIR CARGO MODELS

Equation Number	Time Period	$\hat{\lambda}$	L-max	Constant	$X_{1t}^{(\lambda)}$	$X_{2t}^{(\lambda)}$	$X_{5t}^{(\lambda)}$	D-W	R^2
(3.4.1)	1950-1977	0.6	-120.69	68.38	2.39	-16.54	-0.095	1.85	0.99
				(1.04)	(9.72)	(-5.59)	(-0.01)		
(3.4.2)	1955-1977	0.6	-102.93	89.9	2.31	-17.28	-1.26	1.83	0.99
				(0.69)	(4.66)	(04.34)	(-0.09)		
(3.4.3)	1962-1977	0.6	- 74.0	156.12	2.07	-21.93	----		
				(1.85)	(5.78)	(-4.55)		2.40	0.98

TABLE 3.4.3

THE ESTIMATED PASSENGER/CARGO CARRIER MODELS

Equation Number	Time Period	$\hat{\lambda}$	L-max	Constant	$X_{1t}^{(\lambda)}$	$X_{3t}^{(\lambda)}$	$X_{5t}^{(\lambda)}$	R-W	R^2
(3.4.4)	1950-1977	0.2	-109.7	0.887	2.15	-4.87	2.24	1.67	0.99
				(0.14)	(10.04)	(-8.22)	(2.06)		
(3.4.5)	1955-1977	0.2	-100.33	-2.44	2.33	-5.00	2.52	1.42	0.99
				(0.16)	(4.61	(-4.60)	(1.38)		
(3.4.6)	1960-1977	0.2	- 81.97	5.92	2.00	-5.38	2.09	1.82	0.99
				(0.41)	(4.07)	(-5.65)	(1.12)		
(3.4.7)	1962-1977	0.2	- 75.68	5.28	2.03	-5.54	2.39	1.88	0.98
				(0.33)	(3.77)	(-5.33)	(1.14)		
(3.4.8)	1962-1977	0.4	- 75.71	54.96	1.81	-11.5	---	1.69	0.98
				(1.89)	(4.77)	(-5.54)			
(3.4.9)	1962-1978	0.4	- 81.52	12.59	2.42	- 8.69	---	1.14	0.98
				(0.68)	(10.56)	(-5.63)			

First, it would be plausible that the cross elasticity of demand with respect to the price of motor freight would vary inversely with the length of haul. In the short-distance markets, the speed advantage of air freight would be nullified and thus all traffic would be sensitive to the competitive rate of motor freight. In long distance markets, the advantage of air freight, particularly its speed, would become of far greater importance and tend to dominate the price of motor freight. The average flight stage-length of air freight (domestic trunk) consistently increased from 198.6 in 1950, 411.3 in 1965 and to 583.7 in 1976. This indicates that air freight movement has entered into long distance markets.

The second explanation is statistical in nature. The variation of real motor freight price is relatively small (measured in terms of sample range) in the period from 1962 to 1977, compared with the variation of this from 1950 to 1977. Hence, the real motor freight price tends to be colinear with the constant terms of the model estimated with data from 1962 to 1977.

The model for all-cargo carriers, scheduled services, specified in equation (3.2.3) was first estimated with three time periods similar to those of the passenger/cargo model. The motor freight price variable was again insignificant in all three models. Thus, this variable is deleted from the revised models, which are reported in Table 3.4.4.

TABLE 3.4.4

THE ESTIMATED ALL CARGO CARRIER MODELS
(scheduled services)

Equation Number	Time Period	$\hat{\lambda}$	L-max	Constant	$X_{1t}^{(\lambda)}$	$X_{4t}^{(\lambda)}$	$Y_{2t-1}^{(\lambda)}$	X_{6t}	D-W	R^2
(3.4.9)	1962-1977	0	-55.59	-15.04	3.17	-0.51			0.80	0.94
				(-3.21)	(8.08)	(-0.67)				
(3.4.10)	1962-1977	0	-52.91	- 5.68	1.39	-0.42	0.50		1.29	0.95
					(1.76)	(-0.65)	(2.48)			
(3.4.11)	1962-1978	0	-59.82	-14.33	3.12	-0.68	----	0.44	0.74	0.95
				(03.85)	(9.71)	(-1.1)		(2.47)		
(3.4.12)	1962-1978	0	-57.1	- 7.09	1.59	-0.36	0.47	0.44	1.21	0.97
				(1.46)	(2.12)	(-0.69)	(2.39)	(2.81)		

X_{6t} = Dummy variable denotes one for the year 1978 and 0's otherwise. This variable is used to take account of deregulation effect on all cargo carriers, scheduled services.

The low D-W statistics of equation (3.4.9) suggest that either the errors may be distributed as first-order autoregressive process or the possiblity of misspecification of the model. Thus, the equation was extended into two enlarged models: generalized functional forms with first-order autocorrelated errors; and, generalized functional forms with partial adjustment hypothesis with independent errors. The estimated coefficient of $X_1(\lambda)_{,t-1}$, the variable of GNP 72 lagged one period, is statistically insignificant at the 10 percent level of significance. Hence, the generalized functional form with partial adjustment hypothesis is preferred in our case and the estimated version of this model is presented in Table 3.4.4.

The regression results of all-cargo carriers, non-scheduled services, are very disappointing. It is because the non-scheduled series fluctuates widely over this sample period, indicating that the random component of the services dominates the systematic part of the series. For forecasting purposes we treat non-scheduled services as a 3.3 percent of the scheduled services of all-cargo carriers.

After we completed our empirical study, 1978 air cargo data became available to us. In order to incorporate the updated information, we re-estimated the equation (3.4.8) of the passenger/cargo carrier model and equation (3.4.10) of the all-cargo carrier model. It is interesting to observe that the all-cargo

carrier, scheduled service, traffic has increased from 507 RTM in 1977 to 841 RTM in 1978. A dummy variable X_{6t} was adopted to take account of the deregulation effects on all air cargo carriers, scheduled services. The updated passenger/cargo and all-cargo model are presented in equation (3.4.9) of Table 3.4.3 and equation (3.4.12) of Table 3.4.4, respectively.

The elasticity of a given regressor, X_i, $i = 1,2,\ldots, K$, evaluated at the sample mean for the generalized functional form (2.2) is

$$E_i = \beta_i \left(\frac{\bar{X}_i^{\lambda}}{\bar{Y}_i^{\lambda}} \right)$$

The estimated elasticity coefficients are summarized in Table 3.4.5.

In the aggregate model, the elasticity with respect to GNP in 1972 is 1.81 and price elasticity is -1.6 in the period of 1950 to 1977. The income elasticity of 1.81 can be interpreted that domestic air cargo will increase 18.1 percent as GNP in 1972 dollars increases 10 percent. Both income and price elasticities decrease to 1.35 and -1.51 income and price elasticities decrease to 1.35 and -1.51 respectively in the period from 1962 to 1977.

TABLE 3.4.5

ESTIMATED ELASTICITIES
CALCULATED AT THE SAME TIME

Equation Number	Time Period	GNP72	Price	Motor Freight Price
			Aggregate Models	
(3.4.1)	1950-1977	1.81*	-1.60*	----
(3.4.2)	1955-1977	1.85*	-1.47*	----
(3.4.3)	1962-1977	1.35*	-1.51*	----
			Passenger/Cargo Carrier Models	
(3.4.4)	1950-1977	2.05*	-2.37*	0.85*
(3.4.5)	1955-1977	2.18*	-2.33*	0.91
(3.4.7)	1962-1977	1.94*	-2.50*	0.87
(3.4.8)	1962-1977	1.49*	-2.40*	----
(3.4.9)	1962-1978	1.97*	-1.61	----
			All Cargo Carrier Model	
			(short-run)	
(3.4.10)	1962-1977	1.37*	-0.42	----
			(long-run)	
		2.74*	-0.84	----
			(short-run)	
(3.4.12)	1962-1978	1.58*	-0.36	
			(long-run)	
		3.27*	-0.76	

*Indicates significance at the 0.05 level.

In the passenger cargo model, the elasticity with respect to GNP lies in the range of 1.49 to 2.05, while the price elasticity remains relatively stable and is in the range of -2.33 to -2.50. The cross elasticity with respect to real motor freight price is 0.85 (inelastic) and statistically significant in the period 1950 to 1977. It becomes statistically insignificant in the equation (3.4.8) estimated with data from 1962 to 1977. However, this cross elasticity coefficient is roughly the same as the previous one computed from equation (3.4.4).

The coefficient of adjustment is 0.5 in the all-cargo carrier model. Income elasticity is 1.37 in the short-run and 2.74 in the long-run. The price elasticity is inelastic in both the short-run and long-run.

In summary, the Box-Cox transformation technique was used in this section to choose the flexible functional form for the air cargo models. In the passenger/cargo model, the maximum likelihood estimation of λ was found to be 0.4. Consequently, the hypothesis that the functional form is linear or logarithmic was rejected. This provides empirical evidence that conventional specifications of either linear or logarithmic form are not flexible enough to specify the correct functional form.

In the period from 1962 to 1978, the empirical estimate of λ is 0, which supports the specification of logarithmic functional form for the all-cargo air carrier model.

The variables of GNP in 1972 dollars, real price, and real motor freight price have the expected signs and are statistically significant in the passenger/cargo model for the period 1950 to 1977. The coefficient of real motor freight price still possesses correct signs but becomes insignificant in the same model estimated with data from 1962 to 1977.

The dynamic model is preferred over the static model for all-cargo carrier operations. Both the GNP in 1972 dollars and the real price variable possess correct signs but the latter variable is not significant in the model.

For forecasting purposes, equations (3.4.9) and (3.4.12) are employed in the next section to forecast passenger/cargo carrier operations and all-cargo carrier operations, scheduled services.

3.5 The Forecasts

The forecasting procedure employed consisted of two steps: extrapolation of independent variables under varying assumptions, and the substitution of these extrapolated variables into the estimated demand equations. The resulting forecasts implicitly assume that basic structural relationships among the variables for the 1962-1978 period will remain unchanged through 1991.

The future values of real yields per revenue ton-mile for domestic passenger/cargo carriers and all-cargo carriers are respectively projected through three alternative growth rates. It is anticipated that these alternative growth rates will bracket the range of probable real values.

Under the increasing air cargo price scenario, the real yields per revenue ton-mile for passenger/cargo carriers and all-cargo carriers respectively are assumed to increase 2 percent annually. Under the constant air cargo price scenario, the real yields per revenue ton-mile for both types of carriers are assumed to remain constant at their 1978 levels throughout the forecasting period. Under the declining air cargo price scenario, which utilized historic 1962 to 1978 average annual growth rates, the real yield per revenue ton-mile is assumed to decline 1.1 percent annually for passenger/cargo carriers and 0.4 percent annually for all-cargo carriers, scheduled services.

Two alternative forecasts of GNP in 1972 dollars from 1979 through 1991 were obtained from forecasts produced from Wharton EFA's annual model, December 6, 1978 (19). The first set of real GNP forecasts was obtained from the post-meeting control solution of the Wharton's annual model. The average growth rate of GNP in 1972 dollars from 1979 to 1991 was 2.9 percent annually. The second set of real GNP forecasts was obtained from solution of Wharton's annual model under the assumption of higher productivity. The corresponding growth rate for the same period was 3.2 percent annually.

Table 3.5.1 presents total domestic air cargo traffic (freight plus express) forecasts. Tables 3.5.2 and 3.5.3 report domestic air cargo traffic forecasts of passenger/cargo carriers and all-cargo carriers respectively. These forecasts are generated with the first set of GNP forecasts and three price scenarios. These forecasts are displayed in Figures 3.5.1 through 3.5.3. The future growth rates of these corresponding forecasts are reported in Tables 3.5.4 through 3.5.6.

Alternative sets of total domestic air cargo traffic (freight plus express) and its component forecasts are presented in

TABLE 3.5.1

TOTAL DOMESTIC AIR CARGO REVENUE TON-MILE FORECAST

(millions)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1979	3858.61	3941.65	3985.25
1980	4036.03	4210.89	4301.21
1981	4289.31	4568.27	4710.76
1982	4556.43	4950.79	5150.5
1983	4783.03	5300.38	5560.62
1984	4980.28	5627.44	5951.32
1985	5265.23	6059.74	6455.24
1986	5557.41	6510.99	6982.99
1987	5830.82	6952.34	7504.4
1988	6067.44	7362.6	7997.07
1989	6364.45	7853.2	8578.71
1990	6656.95	8350.45	9171.35
1991	6954.47	8865.84	9787.37

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

[1]Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields increase 2% annually.

[2]Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields held constant at 1978 level.

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually. Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

TABLE 3.5.2

DOMESTIC PASSENGER/CARGO AIR CARGO REVENUE TON-MILE FORECAST

(millions)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1979	2751.55	2826.73	2868.64
1980	2754.6	2906.87	2992.31
1981	2852.1	3088.09	3221.24
1982	2963.62	3289.35	3474.03
1983	3044.73	3463.35	3701.78
1984	3107.61	3622.05	3916.37
1985	3229.34	3850.36	4206.91
1986	3342.38	4074.91	4496.88
1987	3434.83	4281.8	4771.21
1988	3501.	4463.55	5021.52
1989	3604.72	4693.84	5326.71
1990	3695.26	4914.24	5624.25
1991	3782.95	5136.63	5926.78

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post Meeting Control Solution (average annual growth rate 2.9%).

[1]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

[2]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually.

TABLE 3.5.3

DOMESTIC ALL-CARGO AIR CARGO REVENUE TON-MILE FORECAST

(millions)

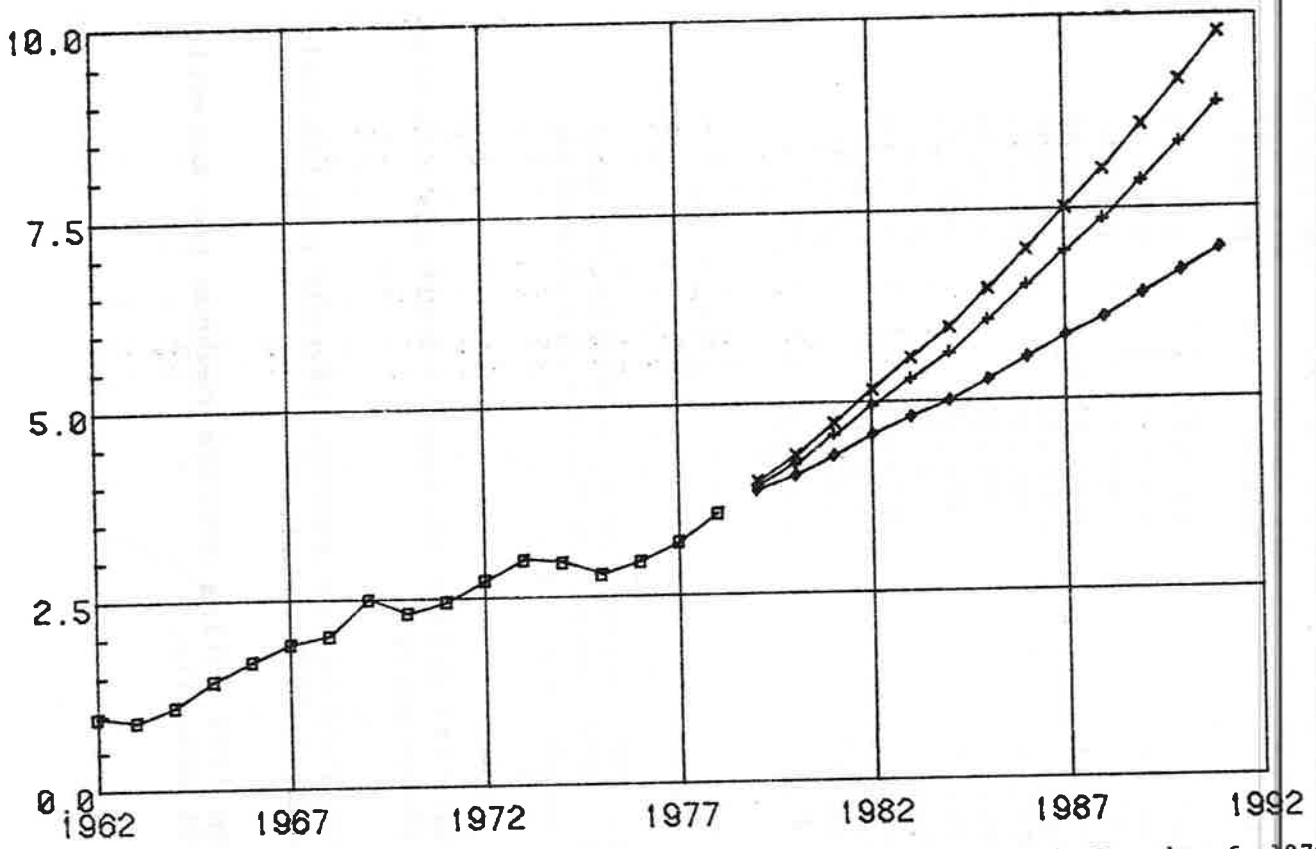
Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1979	1107.07	1114.93	1116.61
1980	1281.43	1304.03	1308.91
1981	1437.21	1480.17	1489.52
1982	1592.82	1661.44	1676.48
1983	1738.3	1837.03	1858.85
1984	1872.67	2005.39	2034.96
1985	2035.89	2209.38	2248.34
1986	2215.03	2436.08	2486.11
1987	2395.99	2670.55	2733.2
1988	2566.45	2899.04	2975.54
1989	2759.73	3159.35	3252.
1990	2961.69	3436.21	3547.1
1991	3171.52	3729.21	3860.59

Forecast utilizes 1972 dollar GNP from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

[1]Domestic all-cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

[2]Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.



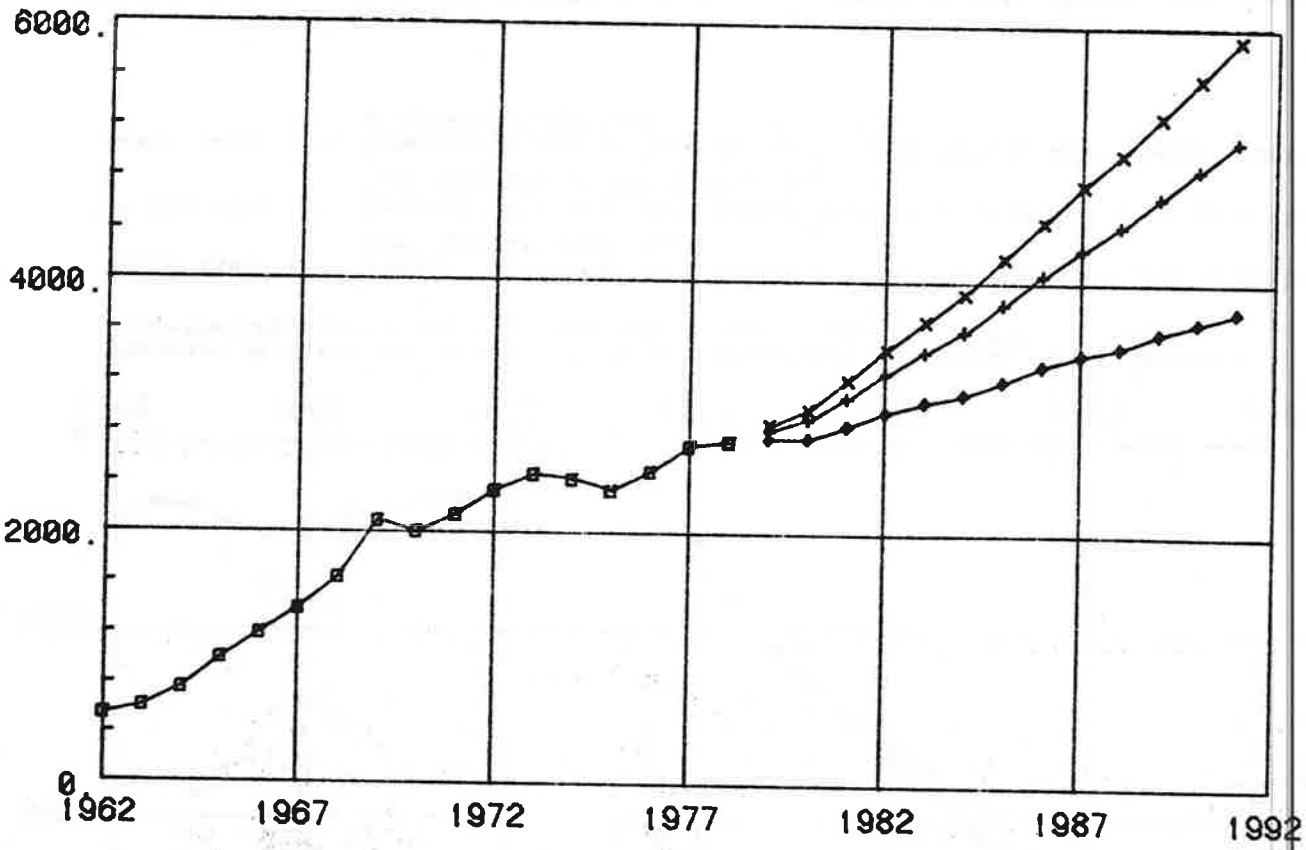
Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%)

Upper line -- Domestic 1972 dollar average revenue per ton-mile yields declines 1.1% annually for passenger/cargo carriers and .4% annually for all-cargo carriers

Middle Line -- Domestic passenger/cargo and all cargo 1972 dollar average revenue per ton-mile yields held constant at 1978 level

Lower Line -- Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields increase 2% annually

FIGURE 3.5.1. U.S. DOMESTIC REVENUE TON-MILES (BILLIONS)



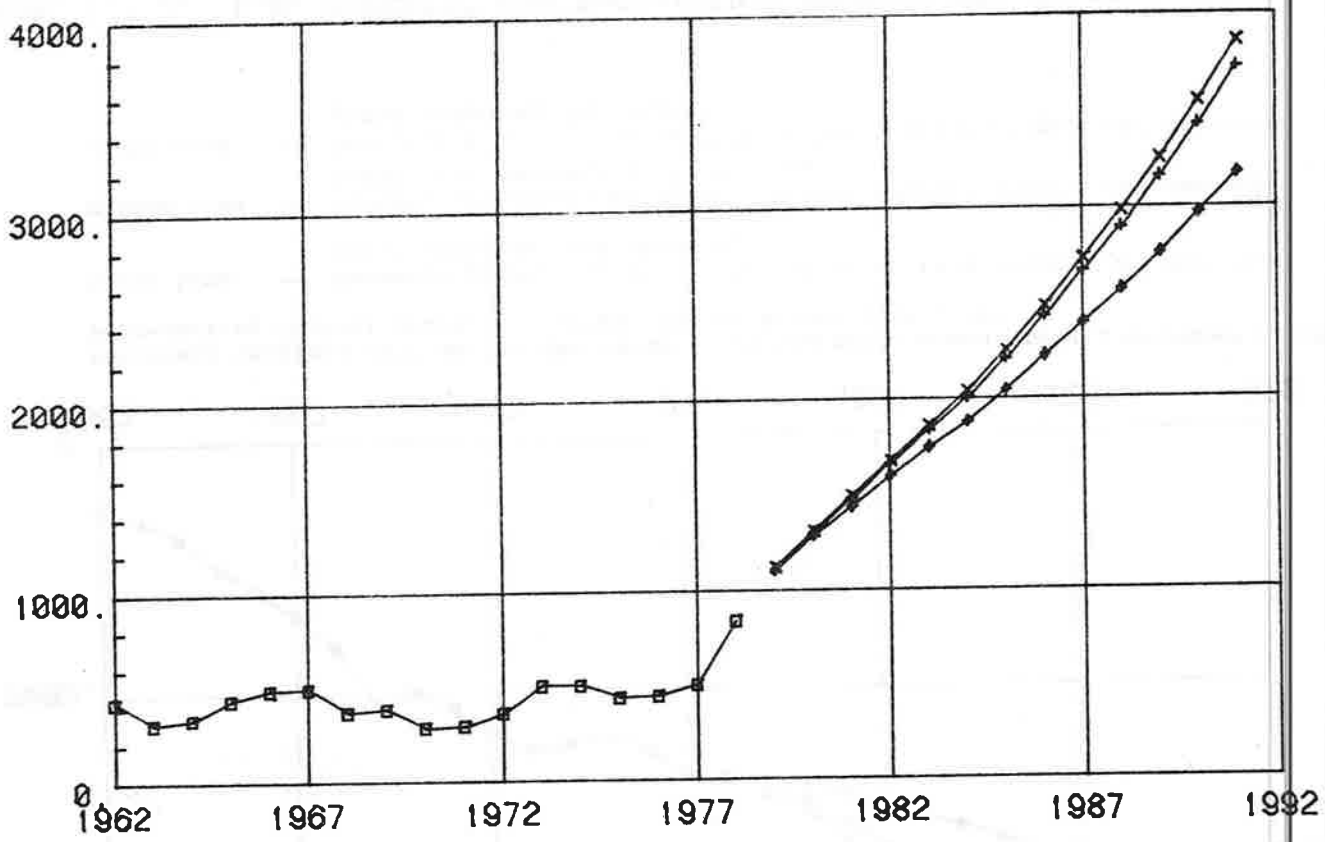
Forecasts utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%)

Upper Line -- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually

Middle Line -- Domestic passenger/cargo 1972 dollar average revneue per ton-mile yield held constant at 1978 level.

Lower Line -- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield increases 2% annually

FIGURE 3.5.2. U.S. DOMESTIC PASSENGER/CARGO REVENUE TON-MILES (MILLIONS)



Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%)

Upper Line -- Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

Middle Line -- Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at the 1978 level.

Lower Line -- Domestic all-cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

FIGURE 3.5.3. U.S. DOMESTIC ALL-CARGO REVENUE TON-MILES (MILLIONS)

TABLE 3.5.4

TOTAL DOMESTIC AIR CARGO REVENUE TON-MILE GROWTH RATE FORECAST

(percent per annum)

Period	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1978-1980	6.4	8.7	9.9
1980-1985	5.5	7.6	8.5
1985-1990	4.8	6.6	7.3
1978-1991	5.3	7.3	8.1

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

[1]Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields increase 2% annually.

[2]Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields held constant at 1978 level.

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually. Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

TABLE 3.5.5

DOMESTIC PASSENGER/CARGO AIR CARGO REVENUE TON-MILE GROWTH RATE FORECAST

(Percent Per Annum)

Period	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1978-1980	.6	3.4	4.9
1980-1985	3.2	5.8	7.1
1985-1990	2.7	5.0	6.0
1978-1991	2.6	5.0	6.2

Forecast utilizes 1972 dollar 1972 GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

[1]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

[2]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually.

TABLE 3.5.6

DOMESTIC ALL-CARGO AIR CARGO REVENUE
TON-MILE GROWTH RATE FORECAST

(Percent Per Annum)

Period	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1978-1980	23.4	24.5	24.7
1980-1985	9.7	11.1	11.4
1985-1990	7.8	9.2	9.5
1978-1991	10.7	12.1	12.4

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

[1]Domestic all-cargo 1972 dollar average revenue per ton-mile yield increasts 2% annually,

[2]Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

Tables 3.5.7 through 3.5.9. These forecasts are computed with the second set of GNP forecasts (3.2 percent annual growth rates) and three real price scenarios.

The future growth rates of these forecasts are reported in Tables 3.5.10 through 3.5.12. The behavior of these second sets of forecasts is displayed in Figures 3.5.4 through 3.5.6.

TABLE 3.5.7

TOTAL DOMESTIC AIR CARGO REVENUE TON-MILE FORECAST

(millions)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1979	3858.61	3941.65	3985.25
1980	4089.5	4265.89	4356.96
1981	4436.2	4721.35	4866.76
1982	4797.	5204.76	5410.51
1983	5112.27	5652.55	5922.74
1984	5378.48	6059.03	6396.91
1985	5731.28	6571.36	6985.51
1986	6033.76	7040.52	7533.55
1987	6328.65	7512.96	8089.43
1988	6612.68	7984.77	8648.91
1989	6947.57	8527.08	9287.11
1990	7261.07	9057.52	9916.9
1991	7650.61	9691.16	10660.9

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

[1]Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields increase 2% annually.

[2]Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields held constant at 1978 level.

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually. Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

TABLE 3.5.8

DOMESTIC PASSENGER/CARGO AIR CARGO REVENUE TON-MILE FORECAST

(millions)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1979	2751.55	2826.73	2868.64
1980	2792.9	2946.43	3032.56
1981	2949.11	3189.81	3325.55
1982	3110.09	3445.19	3635.01
1983	3232.42	3665.93	3912.53
1984	3321.55	3856.31	4161.73
1985	3468.8	4116.08	4486.93
1986	3570.34	4331.26	4768.64
1987	3665.43	4544.54	5051.37
1988	3751.14	4752.37	5331.22
1989	3864.52	4997.59	5654.12
1990	3954.6	5221.29	5956.86
1991	4084.32	5497.76	6319.82

Forecast utilizes 1972 dollar GNP values from Whaton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

[1]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

[2]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually.

TABLE 3.5.9

DOMESTIC ALL-CARGO AIR CARGO REVENUE TON-MILE FORECAST

(millions)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1979	1107.07	1114.93	1116.61
1980	1296.6	1319.46	1324.4
1981	1487.09	1531.54	1541.21
1982	1686.91	1759.58	1775.51
1983	1879.85	1986.62	2010.21
1984	2056.94	2202.72	2235.19
1985	2262.48	2455.29	2498.58
1986	2463.42	2709.26	2764.91
1987	2663.23	2968.42	3038.05
1988	2861.55	3232.4	3317.69
1989	3083.05	3529.49	3632.99
1990	3306.48	3836.24	3960.04
1991	3566.29	4193.4	4341.13

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

[1]Domestic all-cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

[2]Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

TABLE 3.5.10

TOTAL DOMESTIC AIR CARGO REVENUE TON-MILE GROWTH RATE FORECAST

(percent per annum)

Period	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1978-1980	7.1	9.4	10.6
1980-1985	7.0	9.0	9.9
1985-1990	4.8	6.6	7.3
1978-1991	6.1	8.0	8.8

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

[1]Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields increase 2% annually.

[2]Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields held constant at 1978 level.

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually. Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

TABLE 3.5.11

DOMESTIC PASSENGER/CARGO AIR CARGO REVENUE
TON-MILE GROWTH RATE FORECAST

(Percent Per Annum)

Period	Increasing Air Cargo Prices[1]	Constant Air Cargo Prices[2]	Declining Air Cargo Prices[3]
1978-1980	1.3	4.1	5.6
1980-1985	4.4	6.9	8.2
1985-1990	2.7	4.9	5.8
1978-1991	3.2	5.6	6.7

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

[1]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

[2]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually.

TABLE 3.5.12

DOMESTIC ALL-CARGO AIR CARGO REVENUE
TON-MILE GROWTH RATE FORECAST

(Percent Per Annum)

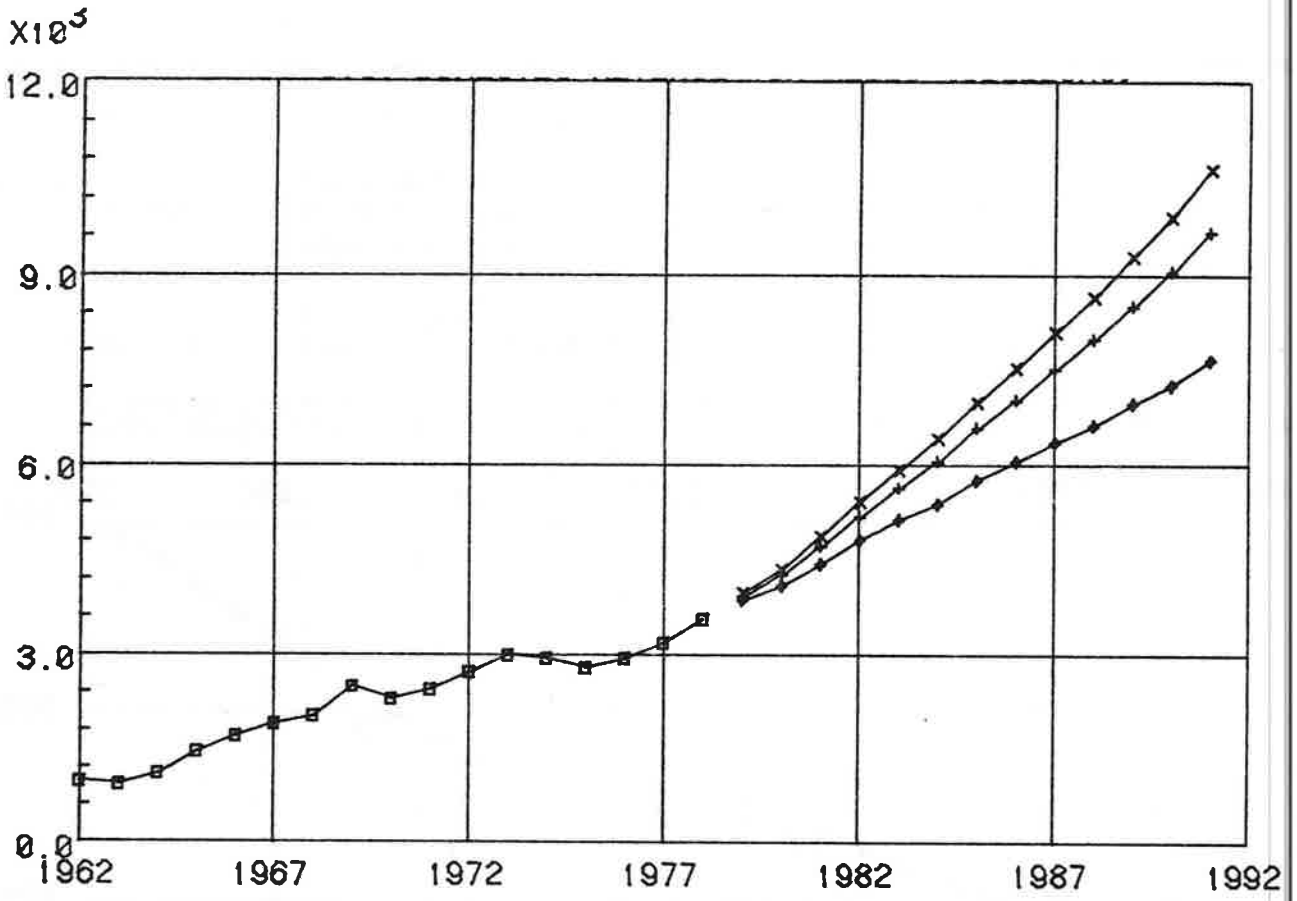
Period	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1978-1980	24.1	25.2	25.4
1980-1985	11.8	13.2	13.5
1985-1990	7.9	9.3	9.6
1978-1991	11.7	13.1	13.4

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

[1]Domestic all-cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

[2]Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.



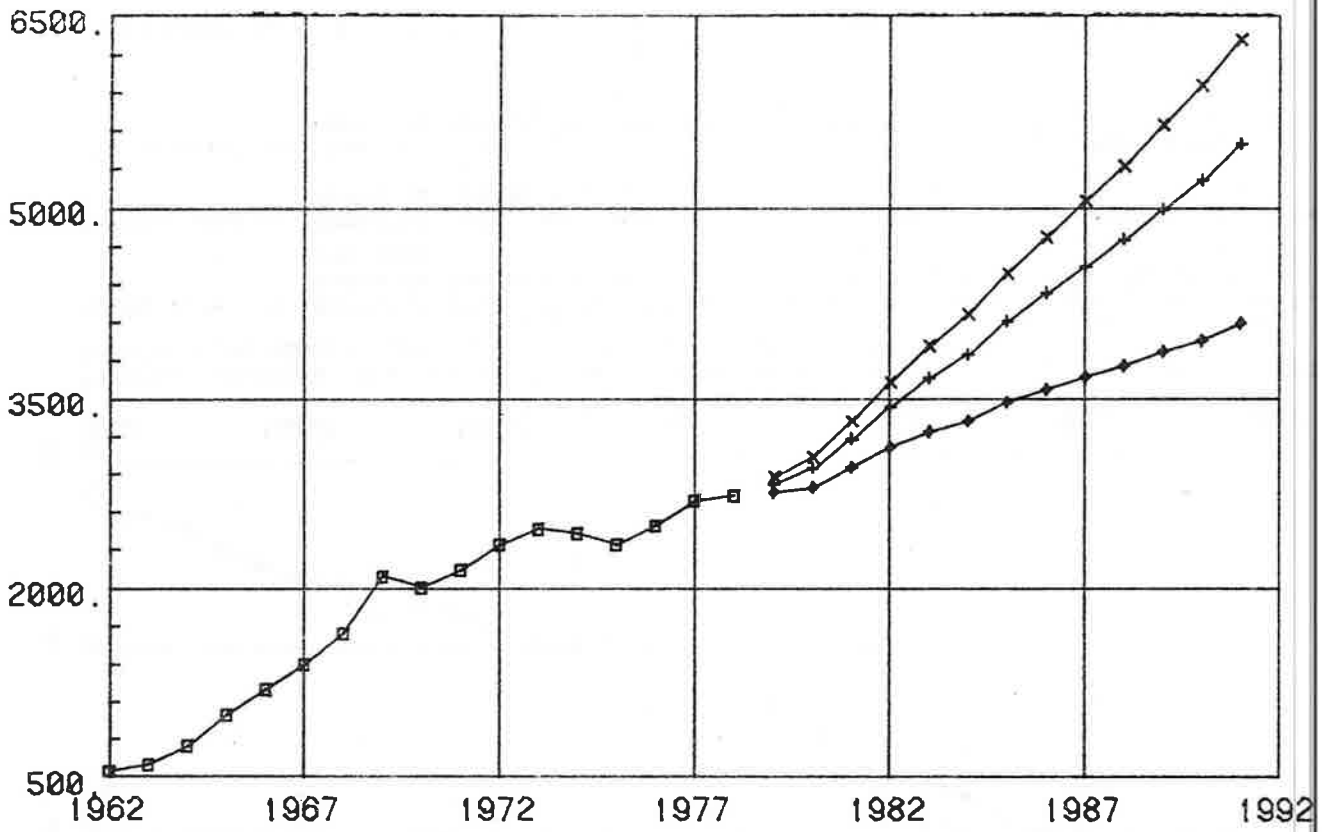
Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity (average annual growth rate 3.2%)

Upper line -- Domestic 1972 dollar average revenue per ton-mile yields declines 1.1% annually for passenger/cargo carriers and .4% annually for all-cargo carriers

Middle Line -- Domestic passenger/cargo and all cargo 1972 dollar average revenue per ton-mile yields held constant at 1978 level

Lower Line -- Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields increase 2% annually

FIGURE 3.5.4. U.S. DOMESTIC REVENUE TON-MILES (BILLIONS)



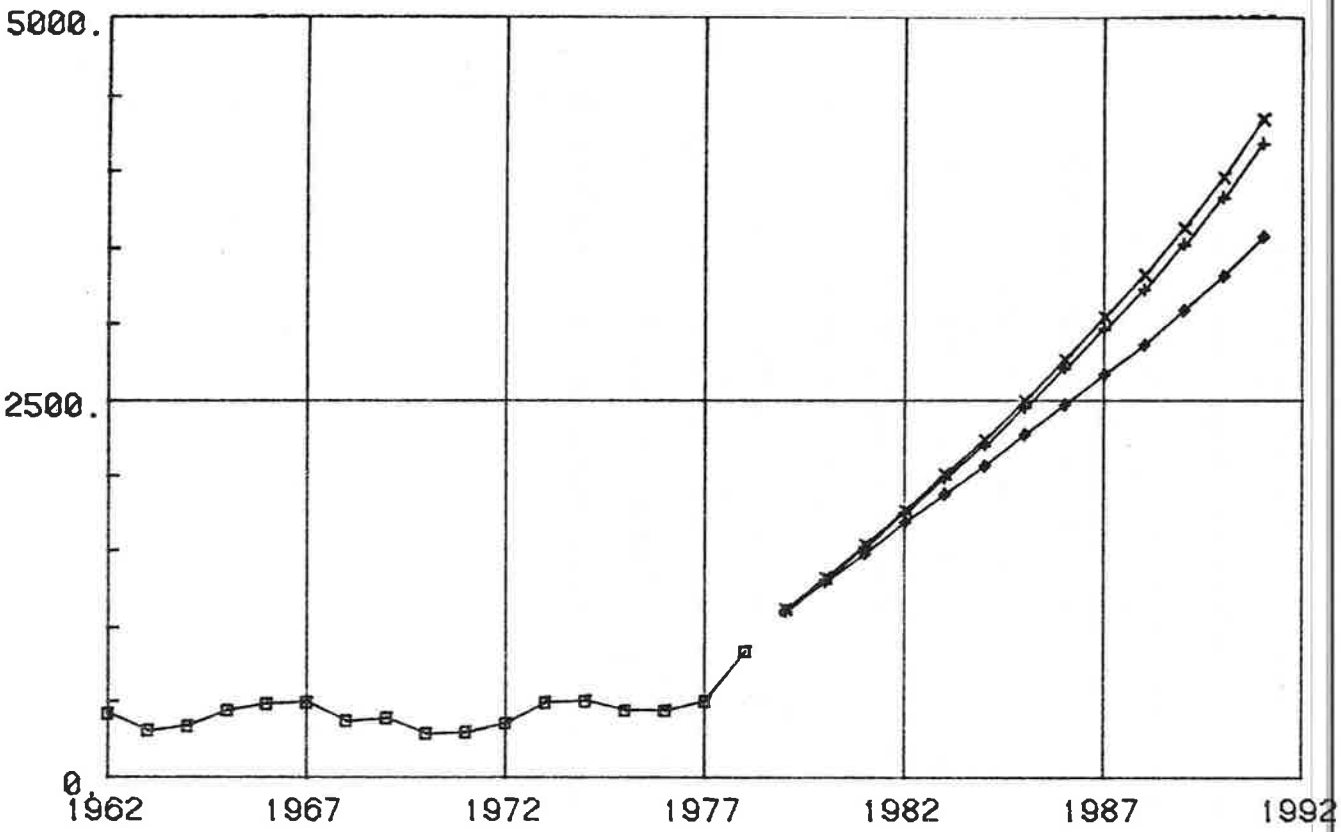
Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity (average annual growth rate 3.2%)

Upper Line -- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually

Middle Line -- Domestic passenger/cargo 1972 dollar average revneue per ton-mile yield held constant at 1978 level.

Lower Line -- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield increases 2% annually

FIGURE 3.5.5. U.S. DOMESTIC PASSENGER/CARGO REVENUE TON-MILES (MILLIONS)



Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity (average annual growth rate 3.2%)

Upper Line -- Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

Middle Line -- Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at the 1978 level.

Lower Line -- Domestic all-cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

FIGURE 3.5.6. U.S. DOMESTIC ALL-CARGO REVENUE TON-MILES (MILLIONS)

3.6 Conversion from Revenues Ton-Miles to Tons

The revenue ton-mile (RTM) is the standard industry measure of air carrier production of freight transportation service. The enplaned ton is more direct measure of freight activity at U.S. airports. Both measures are required for airways and airport facilities planning by Federal, state and local agencies.

Domestic average length of haul distances for passenger/cargo and all-cargo carriers respectively are computed by dividing aggregate revenue ton-miles flown in domestic freight and express service* by their corresponding enplaned tonnage statistics.** Tables 3.6.1 and 3.6.2 present historic 1971-1978 domestic air cargo revenue ton-miles, tons enplaned and average length of haul distances for passenger/cargo and all-cargo carriers respectively. Plots of domestic air cargo average length of haul distances for passenger/cargo and all-cargo carriers respectively are presented in Figure 3.6.1 and 3.6.2.

*Source: CAB Air Carrier Traffic Statistics

**Source: CAB Airport Activity Statistics

TABLE 3.6.1

DOMESTIC PASSENGER/CARGO CARRIER

AVERAGE LENGTH OF HAUL
(miles)

YEAR	REVENUE TON-MILES (million ton miles)	TONS ENPLANED (tons)	AVERAGE HAUL (miles)
1971	2139.3	2025532	1056
1972	2346.5	1941341	1209
1973	2470.0	2410117	1025
1974	2432.0	2286192	1064
1975	2339.2	1623095	1441
1976	2492.9	2398375	1039
1977	2687.4	2348425	1144
1978	2721.0	2396334	1135

Source: CAB Air Carrier Traffic Statistics

CAB Airport Activity Statistics (compiled from CAB Form 41 schedules T1, T3A and T3C)

TABLE 3.6.2

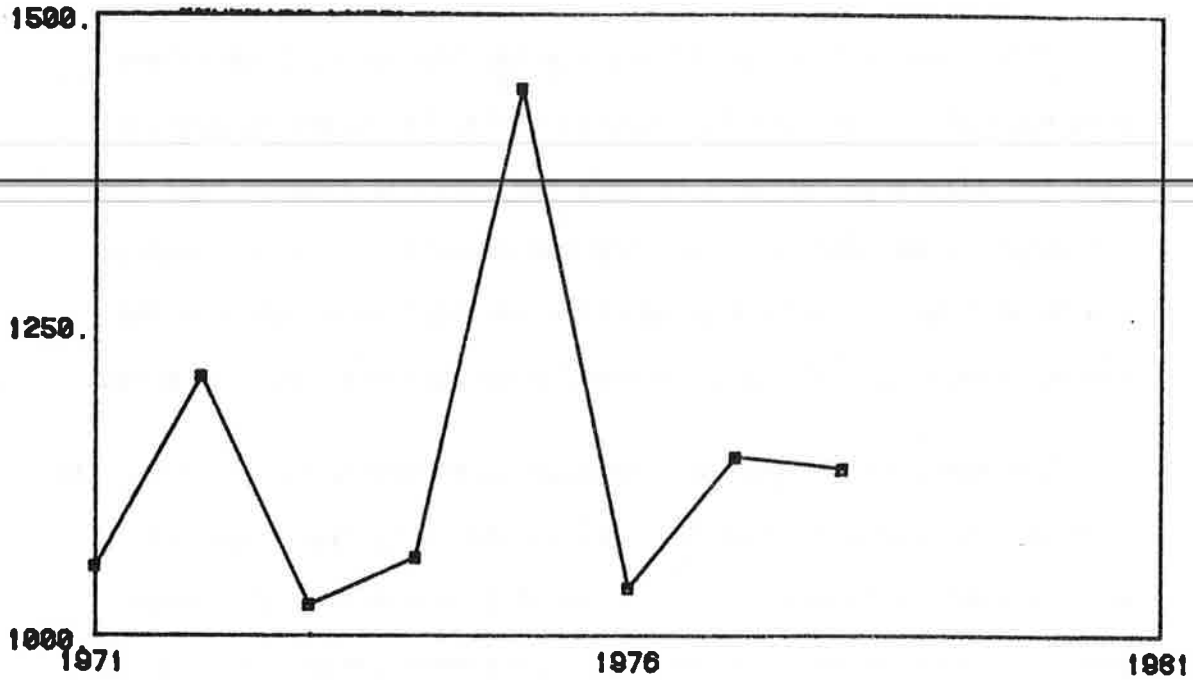
DOMESTIC ALL-CARGO CARRIER

AVERAGE LENGTH OF HAUL
(miles)

YEAR	REVENUE TON-MILES (million ton-miles)	TONS ENPLANED (tons)	AVERAGE HAUL (miles)
1971	299.97	169802	1767
1972	369.02	217613	1696
1973	505.19	306710	1647
1974	508.41	321408	1582
1975	446.09	214048	2084
1976	452.37	285642	1584
1977	507.06	330226	1535
1978	841.82	501158	1680

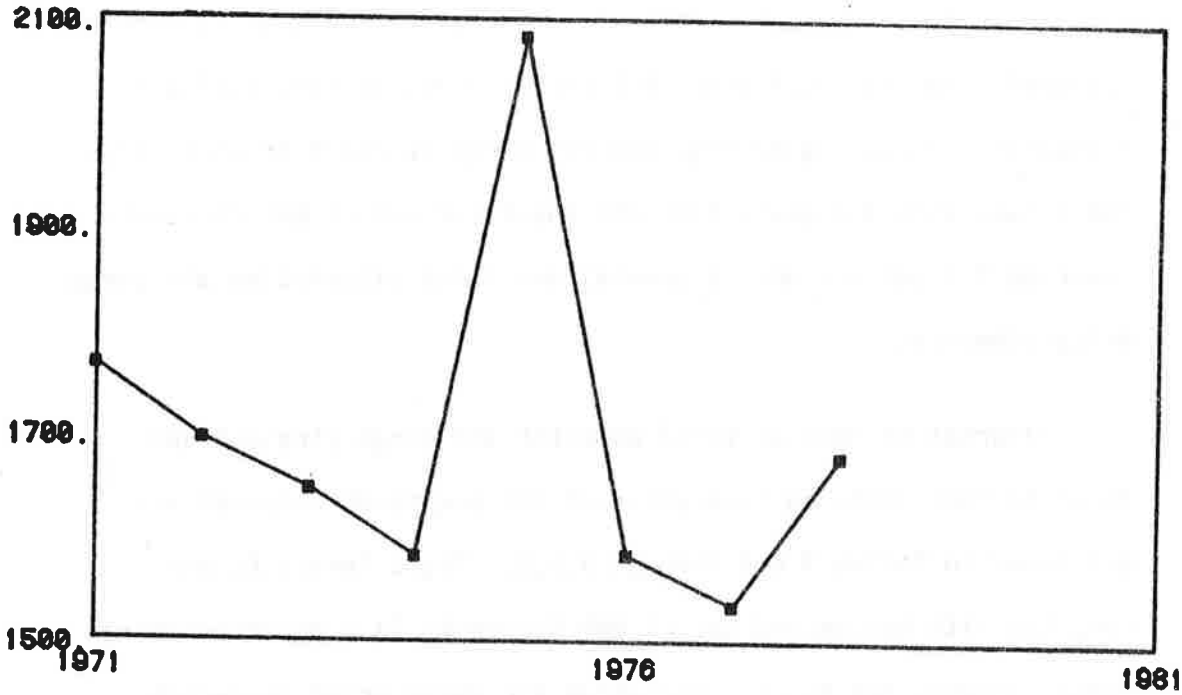
Sources: CAB Air Carrier Traffic Statistics

CAB Airport Activity Statistics (Compiled from CAB Form 41 schedules T1, T3A and T3C)



Source: CAB Air Carrier Traffic Statistics and CAB Airport Activity Statistics

FIGURE 3.6.1. DOMESTIC PASSENGER/CARGO AIR CARGO AVERAGE LENGTH OF HAUL (MILES)



Source: CAB Air Carrier Traffic Statistics and CAB Airport Activity Statistics

FIGURE 3.6.2. DOMESTIC ALL-CARGO AIR CARGO AVERAGE LENGTH OF HAUL (MILES)

All-cargo carriers participate primarily in the high volume, long-haul air cargo markets. Consequently, the domestic average haul for all-cargo carriers exceeds the domestic average haul for passenger/cargo carriers. In 1978 the domestic air cargo average length of haul for all-cargo carriers was 1680 miles whereas the average domestic haul for passenger/cargo carriers was 1135 miles.

The forecasts of enplaned tonnage were obtained by dividing the domestic air cargo revenue ton-mile forecasts by the projected average haul distances. It was assumed that domestic air cargo average length of haul distances for passenger/cargo and all-cargo carriers respectively remained constant at their 1978 levels throughout the forecast period.

Table 3.6.3 presents forecasts of total domestic air cargo tons enplaned. Tables 3.6.4 and 3.6.5 report domestic tons enplaned forecasts for passenger/cargo and all-cargo carriers respectively. These forecasts are generated with the first set of GNP forecasts (average 2.9 percent annual growth) and three alternative air cargo price scenarios.

Alternative sets of total domestic air cargo (freight and express) tons enplaned forecasts and its component forecast are presented in Tables 3.6.6 through 3.6.8. These forecasts are computed with the second set of GNP forecasts (3.2 percent average annual growth) and three alternative air cargo price scenarios.

TABLE 3.6.3

TOTAL DOMESTIC AIR CARGO ENPLANED FORECAST, CASE 1
(tons)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Price	Declining[3] Air Cargo Prices
1978	2897492	2897492	2897492
1979	3083237	3154154	3192085
1980	3189717	3337322	3415508
1981	3368345	3601841	3724716
1982	3559222	3887057	4058171
1983	3717285	4144877	4367934
1984	3852666	4394920	4661828
1985	4057070	4707495	5044820
1986	4263297	5040279	5441833
1987	4452464	5362120	5830607
1988	4612226	5658268	6195402
1989	4818663	6016108	6628853
1990	5018644	6375089	7066654
1991	5220803	6745432	7519801

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%). Forecast assumes a domestic passenger/cargo average haul of 1135 miles and a domestic all-cargo average haul of 1680 miles.

[1] Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields increase 2% annually.

[2] Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields held constant at 1978 level.

[3] Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually. Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

TABLE 3.6.4

DOMESTIC AIR CARGO PASSENGER/CARGO ENPLANED FORECAST, CASE 1

(tons)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1978	2396334	2396334	2396334
1979	2424269	2490508	2527435
1980	2426961	2561116	2636397
1981	2512865	2720785	2838097
1982	2611114	2898107	3060814
1983	2682582	3051406	3261479
1984	2737979	3191234	3450545
1985	2845234	3392388	3706525
1986	2944830	3590232	3962004
1987	3026281	3772508	4203704
1988	3084580	3932647	4424246
1989	3175965	4135541	4693139
1990	3255736	4329728	4955283
1991	3332992	4525664	5221933

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 5, 1978, Post Meeting Control Solution (average annual growth rate 2.9%). Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

[1]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

[2]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually.

TABLE 3.6.5

DOMESTIC ALL-CARGO AIR CARGO ENPLANED FORECAST, CASE 1

(tons)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1978	501158	501158	501158
1979	658969	663647	664651
1980	762756	776207	779111
1981	855481	881056	886620
1982	948108	988951	997904
1983	1034703	1093471	1106455
1984	1114687	1193686	1211283
1985	1211836	1315107	1338295
1986	1318467	1450047	1479829
1987	1426183	1589612	1626903
1988	1527646	1725621	1771156
1989	1642698	1880567	1935714
1990	1762908	2045361	2111371
1991	1887811	2219768	2297968

Forecast utilizes 1972 dollar GNP from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%). Forecast assumes a domestic all-cargo average haul of 1680 miles.

[1]Domestic all-cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

[2]Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

TABLE 3.6.6

TOTAL DOMESTIC AIR CARGO ENPLANED FORECAST, CASE 2
(tons)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1978	2897492	2897492	2897492
1979	3083237	3154154	3192085
1980	3232490	3381362	3460194
1981	3483506	3722033	3847388
1982	3744281	4082774	4259497
1983	3966900	4412403	4643718
1984	4150842	4708774	4997188
1985	4402927	5087981	5440492
1986	4611996	5428742	5847223
1987	4814704	5770915	6258911
1988	5008268	6111155	6671926
1989	5240010	6504048	7144093
1990	5452366	6883721	7605504
1991	5721311	7339909	8152123

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 5, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%) Forecast assumes a domestic passenger/cargo average haul of 1135 miles and a domestic all-cargo average haul of 1680 miles.

[1]Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields increase 2% annually.

[2]Domestic passenger/cargo and all-cargo 1972 dollar average revenue per ton-mile yields held constant at 1978 level.

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually. Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

TABLE 3.6.7

DOMESTIC AIR CARGO PASSENGER/CARGO ENPLANED FORECAST, CASE 2
(tons)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1978	2396334	2396334	2396334
1979	2424269	2490508	2527435
1980	2460706	2595969	2671862
1981	2598337	2810401	2929999
1982	2740169	3035407	3202649
1983	2847942	3229892	3447163
1984	2926475	3397633	3666719
1985	3056211	3626500	3953242
1986	3145676	3816086	4201445
1987	3229449	4004000	4450547
1988	3304966	4187111	4697112
1989	3404862	4403163	4981598
1990	3484226	4600248	5248336
1991	3598518	4843839	5568120

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%) Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

[1]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

[2]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually.

TABLE 3.6.8

DOMESTIC ALL-CARGO AIR CARGO ENPLANED FORECAST, CASE 2

(tons)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1978	501158	501158	501158
1979	658969	663647	664651
1980	771784	785394	788333
1981	885170	911632	917389
1982	1004112	1047367	1056848
1983	1118958	1182511	1196555
1984	1224367	1311141	1330469
1985	1346716	1461481	1487250
1986	1466320	1612656	1645778
1987	1585255	1766915	1808364
1988	1703302	1924044	1974814
1989	1835148	2100885	2162495
1990	1968140	2283473	2357168
1991	2122793	2496070	2584003

Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%). Forecast assumes domestic all-cargo average haul of 1680 miles.

[1]Domestic all-cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

[2]Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

3.7 Tons Enplaned Forecasts by Airport

Table 3.7.1 presents total domestic air cargo (freight plus express) tons enplaned in 1978 at 38 airports. Both passenger/cargo tons enplaned and all-cargo tons enplaned are presented. The top 7 airports accounted for 53 percent of the total domestic 2.9 million air cargo tons enplaned in 1978. The domestic air cargo tons enplaned forecasts by airport assume that the 1978 geographic distribution of air cargo shipments and each airport's 1978 passenger/cargo and all-cargo tons enplaned market shares remain unchanged throughout the forecast period.

Tables 3.7.2 through 3.7.4 present domestic passenger/cargo air cargo (freight and express) tons enplaned forecasts generated with the first set of real GNP forecasts under increasing air cargo price, constant air cargo price and declining air cargo price scenarios respectively. Table 3.7.5 through 3.7.7 present alternative domestic passenger/cargo tons enplaned forecasts generated with the second set of GNP forecasts.

These forecasts assume a domestic passenger/cargo average haul of 1135 miles. The forecasts assume that each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

(tons)

Airport Code	City/State	Pass/Cargo	All-Cargo	Total
ORD	CHICAGO, ILL. (OHARE AIRPORT)	288847	106095	394942
LAX	LOS ANGELES, CALIF.	276438	57946	334384
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	170495	65633	236128
SFO	SAN FRANCISCO, CALIF.	149982	41780	191762
ATL	ATLANTA, GA.	115922	24854	140776
SEA	SEATTLE, WASH.	84423	22755	107178
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	86421	41126	127547
DFW	DALLAS/FT. WORTH, TEXAS	91478	4967	96445
HNL	HONOLULU, OAHU, HAWAII	67684	0	67684
BOS	BOSTON, MASS.	53396	21801	75197
DEN	DENVER, COLORADO	68984	0	68984
MIA	MIAMI, FLORIDA	49370	6684	56054
CLE	CLEVELAND, OHIO	35807	12982	48789
PHL	PHILADELPHIA, PA.	40629	10993	51622
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	0	43355
IAH	HOUSTON, TEXAS	42450	9829	52279
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	0	42292
ANC	ANCHORAGE, ALASKA	29918	55967	85885
STL	ST. LOUIS, MO.	29360	0	29360
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	0	28443
ITO	HILO, HAWAII, HAWAII	18179	0	18179
MEM	MEMPHIS, TENN.	21082	0	21082
PDX	PORTLAND, OREGON	23113	433	23546
MCI	KANSAS CITY, MO.	20886	0	20886
PIT	PITTSBURGH, PA.	20234	0	20234
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	0	18983
IND	INDIANAPOLIS, IND.	18150	10	18160
BAL	BALTIMORE, MD.	17067	0	17067
TPA	TAMPA, FLORIDA	15747	0	15747
DAY	DAYTON, OHIO	13764	0	13764
MSY	NEW ORLEANS, LA.	13918	0	13918
CLT	CHARLOTTE, N.C.	13794	5370	19164
PHX	PHOENIX, ARIZ.	16052	1	16053
BDL	HARTFORD, CONN.	17023	0	17023
MKE	MILWAUKEE, WIS.	9605	0	9605
BUF	BUFFALO, N.Y.	13209	41	13250
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	0	9141
SYR	SYRACUSE, N.Y.	4014	6161	10175

Source: CAB Airport Activity Statistics

TABLE 3.7.2 -- DOMESTIC AIR CARGO PASSENGER/CARGO ENPLANED FORECAST, CASE 3
(tons)

		1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	288847	292414	342809	392269
LAX	LOS ANGELES, CALIF.	276438	279852	328082	375417
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	170495	172601	202347	231541
SFO	SAN FRANCISCO, CALIF.	149982	151834	178002	203683
ATL	ATLANTA, GA.	115922	117354	137579	157428
SEA	SEATTLE, WASH.	84423	85466	100195	114651
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	86421	87488	102566	117364
DFW	DALLAS/FT. WORTH, TEXAS	91478	92608	108568	124232
HNL	HONOLULU, OAHU, HAWAII	67684	68520	80329	91918
BOS	BOSTON, MASS.	53396	54055	63371	72514
DEN	DENVER, COLORADO	68984	69836	81872	93684
MIA	MIAMI, FLORIDA	49370	49980	58593	67047
CLE	CLEVELAND, OHIO	35807	36249	42496	48628
PHL	PHILADELPHIA, PA.	40629	41131	48219	55176
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	43890	51455	58878
IAH	HOUSTON, TEXAS	42450	42974	50381	57649
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	42814	50193	57435
ANC	ANCHORAGE, ALASKA	29918	30287	35507	40630
STL	ST. LOUIS, MO.	29360	29723	34845	39872
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	28794	33757	38627
ITO	HILO, HAWAII, HAWAII	18179	18404	21575	24688
MEM	MEMPHIS, TENN.	21082	21342	25021	28630
PDX	PORTLAND, OREGON	23113	23398	27431	31389
MCI	KANSAS CITY, MO.	20886	21144	24788	28364
PIT	PITTSBURGH, PA.	20234	20484	24014	27479
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	19217	22529	25780
IND	INDIANAPOLIS, IND.	18150	18374	21541	24649
BAL	BALTIMORE, MD.	17067	17278	20255	23178
TPA	TAMPA, FLORIDA	15747	15941	18689	21385
DAY	DAYTON, OHIO	13764	13934	16335	18692
MSY	NEW ORLEANS, LA.	13918	14090	16518	18901
CLT	CHARLOTTE, N.C.	13794	13964	16371	18733
PHX	PHOENIX, ARIZ.	16052	16250	19051	21799
BDL	HARTFORD, CONN.	17023	17233	20203	23118
MKE	MILWAUKEE, WIS.	9605	9724	11399	13044
BUF	BUFFALO, N.Y.	13209	13372	15677	17938
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	9254	10849	12414
SYR	SYRACUSE, N.Y.	4014	4064	4764	5451

NOTES ON TABLE 3.7.2

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 5, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

- Forecast assumes each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

TABLE 3.7.3 DOMESTIC AIR CARGO PASSENGER/CARGO ENPLANED FORECAST, CASE 4
(tons)

		1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	288847	308578	408733	521669
LAX	LOS ANGELES, CALIF.	276438	295321	391173	499258
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	170495	182141	241259	307921
SFO	SAN FRANCISCO, CALIF.	149982	160227	212232	270873
ATL	ATLANTA, GA.	115922	123841	164035	209360
SEA	SEATTLE, WASH.	84423	90190	119463	152471
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	86421	92324	122290	156080
DFW	DALLAS/FT. WORTH, TEXAS	91478	97727	129446	165213
HNL	HONOLULU, OAHU, HAWAII	67684	72307	95776	122240
BOS	BOSTON, MASS.	53396	57043	75558	96435
DEN	DENVER, COLORADO	68984	73696	97616	124588
MIA	MIAMI, FLORIDA	49370	52742	69861	89164
CLE	CLEVELAND, OHIO	35807	38253	50669	64669
PHL	PHILADELPHIA, PA.	40629	43404	57492	73378
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	46317	61349	78301
IAH	HOUSTON, TEXAS	42450	45350	60069	76666
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	45181	59845	76381
ANC	ANCHORAGE, ALASKA	29918	31962	42335	54033
STL	ST. LOUIS, MO.	29360	31366	41546	53025
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	30386	40248	51369
ITO	HILO, HAWAII, HAWAII	18179	19421	25724	32832
MEM	MEMPHIS, TENN.	21082	22522	29832	38075
PDX	PORTLAND, OREGON	23113	24692	32706	41743
MCI	KANSAS CITY, MO.	20886	22313	29555	37721
PIT	PITTSBURGH, PA.	20234	21616	28632	36543
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	20280	26862	34284
IND	INDIANAPOLIS, IND.	18150	19390	25683	32780
BAL	BALTIMORE, MD.	17067	18233	24151	30824
TPA	TAMPA, FLORIDA	15747	16823	22283	28440
DAY	DAYTON, OHIO	13764	14704	19477	24858
MSY	NEW ORLEANS, LA.	13918	14869	19695	25136
CLT	CHARLOTTE, N.C.	13794	14736	19519	24913
PHX	PHOENIX, ARIZ.	16052	17149	22714	28991
BDL	HARTFORD, CONN.	17023	18186	24088	30744
MKE	MILWAUKEE, WIS.	9605	10261	13592	17347
BUF	BUFFALO, N.Y.	13209	14111	18691	23856
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	9765	12935	16509
SYR	SYRACUSE, N.Y.	4014	4288	5680	7249

NOTES ON TABLE 3.7.3

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

- Forecast assumes each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

TABLE 3.7.4 DOMESTIC AIR CARGO PASSENGER/CARGO ENPLANED FORECAST, CASE 5
(tons)

		1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	288847	317648	446583	597041
LAX	LOS ANGELES, CALIF.	276438	304002	427398	571392
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	170495	187495	263601	352410
SFO	SAN FRANCISCO, CALIF.	149982	164937	231886	310010
ATL	ATLANTA, GA.	115922	127481	179226	239608
SEA	SEATTLE, WASH.	84423	92841	130526	174501
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	86421	95038	133615	178631
DFW	DALLAS/FT. WORTH, TEXAS	91478	100599	141433	189083
HNL	HONOLULU, OAHU, HAWAII	67684	74433	104646	139901
BOS	BOSTON, MASS.	53396	58720	82555	110368
DEN	DENVER, COLORADO	68984	75862	106655	142589
MIA	MIAMI, FLORIDA	49370	54293	76330	102047
CLE	CLEVELAND, OHIO	35807	39377	55361	74012
PHL	PHILADELPHIA, PA.	40629	44680	62816	83979
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	47678	67031	89614
IAH	HOUSTON, TEXAS	42450	46683	65632	87743
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	46509	65387	87417
ANC	ANCHORAGE, ALASKA	29918	32901	46256	61840
STL	ST. LOUIS, MO.	29360	32287	45393	60687
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	31279	43975	58791
ITO	HILO, HAWAII, HAWAII	18179	19992	28106	37576
MEM	MEMPHIS, TENN.	21082	23184	32595	43576
PDX	PORTLAND, OREGON	23113	25418	35735	47774
MCI	KANSAS CITY, MO.	20886	22969	32292	43171
PIT	PITTSBURGH, PA.	20234	22252	31284	41823
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	20876	29349	39237
IND	INDIANAPOLIS, IND.	18150	19960	28062	37516
BAL	BALTIMORE, MD.	17067	18769	26387	35277
TPA	TAMPA, FLORIDA	15747	17317	24346	32549
DAY	DAYTON, OHIO	13764	15136	21280	28450
MSY	NEW ORLEANS, LA.	13918	15306	21518	28768
CLT	CHARLOTTE, N.C.	13794	15169	21327	28512
PHX	PHOENIX, ARIZ.	16052	17653	24818	33179
BDL	HARTFORD, CONN.	17023	18720	26319	35186
MKE	MILWAUKEE, WIS.	9605	10563	14850	19853
BUF	BUFFALO, N.Y.	13209	14526	20422	27303
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	10052	14133	18894
SYR	SYRACUSE, N.Y.	4014	4414	6206	8297

NOTES ON TABLE 3.7.4

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

- Forecast assumes each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually.

TABLE 3.7.5 DOMESTIC AIR CARGO PASSENGER/CARGO ENPLANED FORECAST, CASE 6
(tons)

		1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	288847	296478	368231	419799
LAX	LOS ANGELES, CALIF.	276438	283741	352411	401764
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	170495	174999	217352	247791
SFO	SAN FRANCISCO, CALIF.	149982	153944	191202	217978
ATL	ATLANTA, GA.	115922	118985	147781	168476
SEA	SEATTLE, WASH.	84423	86653	107625	122697
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	86421	88704	110172	125601
DFW	DALLAS/FT. WORTH, TEXAS	91478	93895	116619	132950
HNL	HONOLULU, OAHU, HAWAII	67684	69472	86286	98369
BOS	BOSTON, MASS.	53396	54807	68071	77604
DEN	DENVER, COLORADO	68984	70807	87943	100259
MIA	MIAMI, FLORIDA	49370	50674	62938	71752
CLE	CLEVELAND, OHIO	35807	36753	45648	52040
PHL	PHILADELPHIA, PA.	40629	41702	51795	59049
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	44500	55270	63010
IAH	HOUSTON, TEXAS	42450	43572	54117	61695
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	43409	53915	61465
ANC	ANCHORAGE, ALASKA	29918	30708	38140	43482
STL	ST. LOUIS, MO.	29360	30136	37429	42671
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	29194	36260	41338
ITO	HILO, HAWAII, HAWAII	18179	18659	23175	26421
MEM	MEMPHIS, TENN.	21082	21639	26876	30640
PDX	PORTLAND, OREGON	23113	23724	29465	33592
MCI	KANSAS CITY, MO.	20886	21438	26626	30355
PIT	PITTSBURGH, PA.	20234	20769	25795	29407
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	19485	24200	27589
IND	INDIANAPOLIS, IND.	18150	18630	23138	26378
BAL	BALTIMORE, MD.	17067	17518	21758	24804
TPA	TAMPA, FLORIDA	15747	16163	20075	22886
DAY	DAYTON, OHIO	13764	14128	17547	20004
MSY	NEW ORLEANS, LA.	13918	14286	17743	20228
CLT	CHARLOTTE, N.C.	13794	14158	17585	20048
PHX	PHOENIX, ARIZ.	16052	16476	20464	23329
BDL	HARTFORD, CONN.	17023	17473	21701	24741
MKE	MILWAUKEE, WIS.	9605	9859	12245	13960
BUF	BUFFALO, N.Y.	13209	13558	16839	19197
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	9383	11653	13285
SYR	SYRACUSE, N.Y.	4014	4120	5117	5834

NOTES ON TABLE 3.7.5

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

- Forecast assumes each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

TABLE 3.7.6 DOMESTIC AIR CARGO PASSENGER/CARGO ENPLANED FORECAST, CASE 7
(tons)

		1978	1980	1980	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	288847	312778	436942	554266
LAX	LOS ANGELES, CALIF.	276438	299341	418170	530454
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	170495	184621	257909	327161
SFO	SAN FRANCISCO, CALIF.	149982	162408	226879	287799
ATL	ATLANTA, GA.	115922	125526	175356	222442
SEA	SEATTLE, WASH.	84423	91417	127707	161998
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	86421	93581	130730	165832
DFW	DALLAS/FT. WORTH, TEXAS	91478	99057	138380	175536
HNL	HONOLULU, OAHU, HAWAII	67684	73292	102386	129878
BOS	BOSTON, MASS.	53396	57820	80773	102461
DEN	DENVER, COLORADO	68984	74699	104353	132373
MIA	MIAMI, FLORIDA	49370	53460	74682	94736
CLE	CLEVELAND, OHIO	35807	38774	54166	68710
PHL	PHILADELPHIA, PA.	40629	43995	61460	77963
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	46947	65584	83193
IAH	HOUSTON, TEXAS	42450	45967	64215	81457
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	45796	63976	81154
ANC	ANCHORAGE, ALASKA	29918	32397	45257	57409
STL	ST. LOUIS, MO.	29360	31792	44413	56339
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	30800	43026	54579
ITO	HILO, HAWAII, HAWAII	18179	19685	27500	34884
MEM	MEMPHIS, TENN.	21082	22829	31891	40454
PDX	PORTLAND, OREGON	23113	25028	34963	44351
MCI	KANSAS CITY, MO.	20886	22616	31594	40078
PIT	PITTSBURGH, PA.	20234	21910	30608	38827
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	20556	28716	36426
IND	INDIANAPOLIS, IND.	18150	19654	27456	34828
BAL	BALTIMORE, MD.	17067	18481	25817	32750
TPA	TAMPA, FLORIDA	15747	17052	23821	30217
DAY	DAYTON, OHIO	13764	14904	20821	26412
MSY	NEW ORLEANS, LA.	13918	15071	21054	26707
CLT	CHARLOTTE, N.C.	13794	14937	20866	26469
PHX	PHOENIX, ARIZ.	16052	17382	24282	30802
BDL	HARTFORD, CONN.	17023	18433	25751	32665
MKE	MILWAUKEE, WIS.	9605	10401	14530	18431
BUF	BUFFALO, N.Y.	13209	14303	19981	25347
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	9898	13828	17541
SYR	SYRACUSE, N.Y.	4014	4347	6072	7702

NOTES ON TABLE 3.7.6

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 5, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

- Forecast assumes each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

TABLE 3.7.7 DOMESTIC AIR CARGO PASSENGER/CARGO ENPLANED FORECAST, CASE 8
(tons)

		1978	1980	1980	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	288847	321920	476309	632350
LAX	LOS ANGELES, CALIF.	276438	308090	455846	605184
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	170495	190017	281146	373251
SFO	SAN FRANCISCO, CALIF.	149982	167155	247320	328344
ATL	ATLANTA, GA.	115922	129195	191155	253779
SEA	SEATTLE, WASH.	84423	94089	139214	184821
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	86421	96316	142508	189195
DFW	DALLAS/FT. WORTH, TEXAS	91478	101952	150847	200266
HNL	HONOLULU, OAHU, HAWAII	67684	75434	111611	148175
BOS	BOSTON, MASS.	53396	59510	88050	116896
DEN	DENVER, COLORADO	68984	76883	113755	151021
MIA	MIAMI, FLORIDA	49370	55023	81411	108082
CLE	CLEVELAND, OHIO	35807	39907	59046	78389
PHL	PHILADELPHIA, PA.	40629	45281	66997	88946
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	48319	71492	94914
IAH	HOUSTON, TEXAS	42450	47311	70000	92932
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	47134	69740	92587
ANC	ANCHORAGE, ALASKA	29918	33344	49335	65497
STL	ST. LOUIS, MO.	29360	32722	48415	64276
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	31700	46903	62268
ITO	HILO, HAWAII, HAWAII	18179	20260	29977	39798
MEM	MEMPHIS, TENN.	21082	23496	34764	46153
PDX	PORTLAND, OREGON	23113	25759	38113	50599
MCI	KANSAS CITY, MO.	20886	23277	34441	45724
PIT	PITTSBURGH, PA.	20234	22551	33366	44297
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	21157	31303	41558
IND	INDIANAPOLIS, IND.	18150	20228	29929	39734
BAL	BALTIMORE, MD.	17067	19021	28143	37363
TPA	TAMPA, FLORIDA	15747	17550	25967	34474
DAY	DAYTON, OHIO	13764	15340	22697	30132
MSY	NEW ORLEANS, LA.	13918	15512	22951	30470
CLT	CHARLOTTE, N.C.	13794	15373	22746	30198
PHX	PHOENIX, ARIZ.	16052	17890	26470	35141
BDL	HARTFORD, CONN.	17023	18972	28071	37267
MKE	MILWAUKEE, WIS.	9605	10705	15839	21027
BUF	BUFFALO, N.Y.	13209	14721	21782	28917
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	10188	15074	20012
SYR	SYRACUSE, N.Y.	4014	4474	6619	8788

NOTES ON TABLE 3.7.7

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

- Forecast assumes each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually.

Tables 3.7.8 through 3.7.13 present domestic all-cargo tons enplaned forecasts generated under three alternative air cargo price scenarios and two alternative real GNP forecasts. These forecasts assume a domestic all-cargo average haul of 1680 miles. The forecasts assume that each airport's 1978 all-cargo tons enplaned market share remains unchanged throughout the forecast period.

Since the air cargo industry was officially deregulated on January 9, 1978, Flying Tiger has expanded all-cargo service to Anchorage, Atlanta, Houston, Dallas-Fort Worth, Cincinnati and Charlotte. Further all-cargo carrier route expansion is expected during the forecast period. However, forecasting when all-cargo air cargo service will be extended to additional cities is beyond the scope of this study. The all-cargo tons enplaned forecasts by airport unrealistically assume that the 1978 geographic distribution of all-cargo air cargo shipments remains unchanged throughout the forecast period. Consequently, the all-cargo domestic air cargo tons enplaned forecasts by airport are over stated.

Noting this source of forecast error, all cargo tons enplaned forecasts for individual airports should be adjusted according to the judgement of the forecast user.

TABLE 3.7.8 DOMESTIC ALL-CARGO AIR CARGO ENPLANED FORECAST, CASE 3
(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	106095	161499	256583	373262
LAX	LOS ANGELES, CALIF.	57946	88206	140138	203865
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	65633	99907	158729	230909
SFO	SAN FRANCISCO, CALIF.	41780	63598	101042	146990
ATL	ATLANTA, GA.	24854	37833	60108	87441
SEA	SEATTLE, WASH.	22755	34638	55031	80056
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	41126	62602	99460	144689
DFW	DALLAS/FT. WORTH, TEXAS	4967	7561	12012	17475
HNL	HONOLULU, OAHU, HAWAII	0	0	0	0
BOS	BOSTON, MASS.	21801	33186	52724	76700
DEN	DENVER, COLORADO	0	0	0	0
MIA	MIAMI, FLORIDA	6684	10174	16165	23516
CLE	CLEVELAND, OHIO	12982	19761	31396	45673
PHL	PHILADELPHIA, PA.	10993	16734	26586	38675
MSP	MINNEAPOLIS/ST. PAUL, MINN.	0	0	0	0
IAH	HOUSTON, TEXAS	9829	14962	23771	34580
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	0	0	0	0
ANC	ANCHORAGE, ALASKA	55967	85194	135352	196903
STL	ST. LOUIS, MO.	0	0	0	0
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	0	0	0	0
ITO	HILO, HAWAII, HAWAII	0	0	0	0
MEM	MEMPHIS, TENN.	0	0	0	0
PDX	PORTLAND, OREGON	433	659	1047	1523
MCI	KANSAS CITY, MO.	0	0	0	0
PIT	PITTSBURGH, PA.	0	0	0	0
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	0	0	0	0
IND	INDIANAPOLIS, IND.	10	15	24	35
BAL	BALTIMORE, MD.	0	0	0	0
TPA	TAMPA, FLORIDA	0	0	0	0
DAY	DAYTON, OHIO	0	0	0	0
MSY	NEW ORLEANS, LA.	0	0	0	0
CLT	CHARLOTTE, N.C.	5370	8174	12987	18893
PHX	PHOENIX, ARIZ.	1	2	2	4
BDL	HARTFORD, CONN.	0	0	0	0
MKE	MILWAUKEE, WIS.	0	0	0	0
BUF	BUFFALO, N.Y.	41	62	99	144
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	0	0	0	0
SYR	SYRACUSE, N.Y.	6161	9378	14900	21676

NOTES ON TABLE 3.7.8

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

- Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Forecast assumes each airport's 1978 all-cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic all-cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

TABLE 3.7.9 DOMESTIC ALL-CARGO AIR CARGO ENPLANED FORECAST, CASE 4
(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	106095	164348	278448	433066
LAX	LOS ANGELES, CALIF.	57946	89762	152080	236528
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	65633	101669	172255	267905
SFO	SAN FRANCISCO, CALIF.	41780	64720	109652	170541
ATL	ATLANTA, GA.	24854	38500	65230	101451
SEA	SEATTLE, WASH.	22755	35249	59721	92883
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	41126	63707	107936	167871
DFW	DALLAS/FT. WORTH, TEXAS	4967	7694	13036	20275
HNL	HONOLULU, OAHU, HAWAII	0	0	0	0
BOS	BOSTON, MASS.	21801	33771	57217	88989
DEN	DENVER, COLORADO	0	0	0	0
MIA	MIAMI, FLORIDA	6684	10354	17542	27283
CLE	CLEVELAND, OHIO	12982	20110	34072	52991
PHL	PHILADELPHIA, PA.	10993	17029	28851	44872
MSP	MINNEAPOLIS/ST. PAUL, MINN.	0	0	0	0
IAH	HOUSTON, TEXAS	9829	15226	25796	40121
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	0	0	0	0
ANC	ANCHORAGE, ALASKA	55967	86696	146887	228450
STL	ST. LOUIS, MO.	0	0	0	0
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	0	0	0	0
ITO	HILO, HAWAII, HAWAII	0	0	0	0
MEM	MEMPHIS, TENN.	0	0	0	0
PDX	PORTLAND, OREGON	433	671	1136	1767
MCI	KANSAS CITY, MO.	0	0	0	0
PIT	PITTSBURGH, PA.	0	0	0	0
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	0	0	0	0
IND	INDIANAPOLIS, IND.	10	15	26	41
BAL	BALTIMORE, MD.	0	0	0	0
TPA	TAMPA, FLORIDA	0	0	0	0
DAY	DAYTON, OHIO	0	0	0	0
MSY	NEW ORLEANS, LA.	0	0	0	0
CLT	CHARLOTTE, N.C.	5370	8318	14094	21920
PHX	PHOENIX, ARIZ.	1	2	3	4
BDL	HARTFORD, CONN.	0	0	0	0
MKE	MILWAUKEE, WIS.	0	0	0	0
BUF	BUFFALO, N.Y.	41	64	108	167
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	0	0	0	0
SYR	SYRACUSE, N.Y.	6161	9544	16170	25148

NOTES ON TABLE 3.7.9

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

- Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Forecast assumes each airport's 1978 all-cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

TABLE 3.7.10 DOMESTIC ALL-CARGO AIR CARGO ENPLANED FORECAST, CASE 5
(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	106095	164962	283359	447042
LAX	LOS ANGELES, CALIF.	57946	90097	154762	244161
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	65633	102049	175293	276551
SFO	SAN FRANCISCO, CALIF.	41780	64962	111586	176044
ATL	ATLANTA, GA.	24854	38644	66380	104725
SEA	SEATTLE, WASH.	22755	35381	60774	95880
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	41126	63945	109839	173289
DFW	DALLAS/FT. WORTH, TEXAS	4967	7723	13266	20929
HNL	HONOLULU, OAHU, HAWAII	0	0	0	0
BOS	BOSTON, MASS.	21801	33897	58226	91861
DEN	DENVER, COLORADO	0	0	0	0
MIA	MIAMI, FLORIDA	6684	10393	17852	28164
CLE	CLEVELAND, OHIO	12982	20185	34672	54701
PHL	PHILADELPHIA, PA.	10993	17092	29360	46320
MSP	MINNEAPOLIS/ST. PAUL, MINN.	0	0	0	0
IAH	HOUSTON, TEXAS	9829	15283	26251	41415
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	0	0	0	0
ANC	ANCHORAGE, ALASKA	55967	87020	149477	235823
STL	ST. LOUIS, MO.	0	0	0	0
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	0	0	0	0
ITO	HILO, HAWAII, HAWAII	0	0	0	0
MEM	MEMPHIS, TENN.	0	0	0	0
PDX	PORTLAND, OREGON	433	673	1156	1824
MCI	KANSAS CITY, MO.	0	0	0	0
PIT	PITTSBURGH, PA.	0	0	0	0
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	0	0	0	0
IND	INDIANAPOLIS, IND.	10	16	27	42
BAL	BALTIMORE, MD.	0	0	0	0
TPA	TAMPA, FLORIDA	0	0	0	0
DAY	DAYTON, OHIO	0	0	0	0
MSY	NEW ORLEANS, LA.	0	0	0	0
CLT	CHARLOTTE, N.C.	5370	8350	14342	22627
PHX	PHOENIX, ARIZ.	1	2	3	4
BDL	HARTFORD, CONN.	0	0	0	0
MKE	MILWAUKEE, WIS.	0	0	0	0
BUF	BUFFALO, N.Y.	41	64	110	173
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	0	0	0	0
SYR	SYRACUSE, N.Y.	6161	9579	16455	25960

NOTES ON TABLE 3.7.10

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

- Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Forecast assumes each airport's 1978 all-cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

TABLE 3.7.11 DOMESTIC ALL-CARGO AIR CARGO ENPLANED FORECAST, CASE 6

(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	106095	163411	285141	416717
LAX	LOS ANGELES, CALIF.	57946	89250	155736	227599
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	65633	101090	176395	257791
SFO	SAN FRANCISCO, CALIF.	41780	64351	112288	164102
ATL	ATLANTA, GA.	24854	38281	66798	97621
SEA	SEATTLE, WASH.	22755	35048	61156	89376
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	41126	63343	110530	161533
DFW	DALLAS/FT. WORTH, TEXAS	4967	7650	13349	19509
HNL	HONOLULU, OAHU, HAWAII	0	0	0	0
BOS	BOSTON, MASS.	21801	33579	58592	85629
DEN	DENVER, COLORADO	0	0	0	0
MIA	MIAMI, FLORIDA	6684	10295	17964	26253
CLE	CLEVELAND, OHIO	12982	19995	34890	50990
PHL	PHILADELPHIA, PA.	10993	16932	29545	43178
MSP	MINNEAPOLIS/ST. PAUL, MINN.	0	0	0	0
IAH	HOUSTON, TEXAS	9829	15139	26416	38606
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	0	0	0	0
ANC	ANCHORAGE, ALASKA	55967	86202	150417	219825
STL	ST. LOUIS, MO.	0	0	0	0
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	0	0	0	0
ITO	HILO, HAWAII, HAWAII	0	0	0	0
MEM	MEMPHIS, TENN.	0	0	0	0
PDX	PORTLAND, OREGON	433	667	1164	1701
MCI	KANSAS CITY, MO.	0	0	0	0
PIT	PITTSBURGH, PA.	0	0	0	0
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	0	0	0	0
IND	INDIANAPOLIS, IND.	10	15	27	39
BAL	BALTIMORE, MD.	0	0	0	0
TPA	TAMPA, FLORIDA	0	0	0	0
DAY	DAYTON, OHIO	0	0	0	0
MSY	NEW ORLEANS, LA.	0	0	0	0
CLT	CHARLOTTE, N.C.	5370	8271	14432	21092
PHX	PHOENIX, ARIZ.	1	2	3	4
BDL	HARTFORD, CONN.	0	0	0	0
MKE	MILWAUKEE, WIS.	0	0	0	0
BUF	BUFFALO, N.Y.	41	63	110	161
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	0	0	0	0
SYR	SYRACUSE, N.Y.	6161	9489	16558	24199

NOTES ON TABLE 3.7.11

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

- Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Forecast assumes each airport's 1978 all-cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic all-cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

TABLE 3.7.12 DOMESTIC ALL-CARGO AIR CARGO ENPLANED FORECAST, CASE 7
(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	106095	166292	309441	483482
LAX	LOS ANGELES, CALIF.	57946	90824	169008	264064
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	65633	102873	191428	299094
SFO	SAN FRANCISCO, CALIF.	41780	65486	121857	190394
ATL	ATLANTA, GA.	24854	38956	72490	113261
SEA	SEATTLE, WASH.	22755	35666	66368	103696
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	41126	64460	119950	187414
DFW	DALLAS/FT. WORTH, TEXAS	4967	7785	14487	22635
HNL	HONOLULU, OAHU, HAWAII	0	0	0	0
BOS	BOSTON, MASS.	21801	34171	63586	99349
DEN	DENVER, COLORADO	0	0	0	0
MIA	MIAMI, FLORIDA	6684	10476	19495	30459
CLE	CLEVELAND, OHIO	12982	20348	37864	59160
PHL	PHILADELPHIA, PA.	10993	17230	32063	50096
MSP	MINNEAPOLIS/ST. PAUL, MINN.	0	0	0	0
IAH	HOUSTON, TEXAS	9829	15406	28668	44791
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	0	0	0	0
ANC	ANCHORAGE, ALASKA	55967	87722	163236	255046
STL	ST. LOUIS, MO.	0	0	0	0
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	0	0	0	0
ITO	HILO, HAWAII, HAWAII	0	0	0	0
MEM	MEMPHIS, TENN.	0	0	0	0
PDX	PORTLAND, OREGON	433	679	1263	1973
MCI	KANSAS CITY, MO.	0	0	0	0
PIT	PITTSBURGH, PA.	0	0	0	0
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	0	0	0	0
IND	INDIANAPOLIS, IND.	10	16	29	46
BAL	BALTIMORE, MD.	0	0	0	0
TPA	TAMPA, FLORIDA	0	0	0	0
DAY	DAYTON, OHIO	0	0	0	0
MSY	NEW ORLEANS, LA.	0	0	0	0
CLT	CHARLOTTE, N.C.	5370	8417	15662	24471
PHX	PHOENIX, ARIZ.	1	2	3	5
BDL	HARTFORD, CONN.	0	0	0	0
MKE	MILWAUKEE, WIS.	0	0	0	0
BUF	BUFFALO, N.Y.	41	64	120	187
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	0	0	0	0
SYR	SYRACUSE, N.Y.	6161	9657	17969	28076

NOTES ON TABLE 3.7.12

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

- Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Forecast assumes each airport's 1978 all-cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

TABLE 3.7.13 DOMESTIC ALL-CARGO AIR CARGO ENPLANED FORECAST, CASE 8
(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	106095	166914	314896	499085
LAX	LOS ANGELES, CALIF.	57946	91164	171987	272586
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	65633	103257	194803	308746
SFO	SAN FRANCISCO, CALIF.	41780	65730	124006	196539
ATL	ATLANTA, GA.	24854	39102	73768	116916
SEA	SEATTLE, WASH.	22755	35799	67538	107042
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	41126	64701	122064	193462
DFW	DALLAS/FT. WORTH, TEXAS	4967	7814	14742	23365
HNL	HONOLULU, OAHU, HAWAII	0	0	0	0
BOS	BOSTON, MASS.	21801	34298	64707	102555
DEN	DENVER, COLORADO	0	0	0	0
MIA	MIAMI, FLORIDA	6684	10516	19839	31442
CLE	CLEVELAND, OHIO	12982	20424	38531	61069
PHL	PHILADELPHIA, PA.	10993	17295	32628	51713
MSP	MINNEAPOLIS/ST. PAUL, MINN.	0	0	0	0
IAH	HOUSTON, TEXAS	9829	15463	29173	46237
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	0	0	0	0
ANC	ANCHORAGE, ALASKA	55967	88050	166113	263276
STL	ST. LOUIS, MO.	0	0	0	0
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	0	0	0	0
ITO	HILO, HAWAII, HAWAII	0	0	0	0
MEM	MEMPHIS, TENN.	0	0	0	0
PDX	PORTLAND, OREGON	433	681	1285	2037
MCI	KANSAS CITY, MO.	0	0	0	0
PIT	PITTSBURGH, PA.	0	0	0	0
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	0	0	0	0
IND	INDIANAPOLIS, IND.	10	16	30	47
BAL	BALTIMORE, MD.	0	0	0	0
TPA	TAMPA, FLORIDA	0	0	0	0
DAY	DAYTON, OHIO	0	0	0	0
MSY	NEW ORLEANS, LA.	0	0	0	0
CLT	CHARLOTTE, N.C.	5370	8448	15938	25261
PHX	PHOENIX, ARIZ.	1	2	3	5
BDL	HARTFORD, CONN.	0	0	0	0
MKE	MILWAUKEE, WIS.	0	0	0	0
BUF	BUFFALO, N.Y.	41	65	122	193
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	0	0	0	0
SYR	SYRACUSE, N.Y.	6161	9693	18286	28982

NOTES ON TABLE 3.7.13

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

- Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Forecast assumes each airport's 1978 all-cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

Tables 3.7.14 through 3.7.19 present total domestic air cargo tons enplaned forecasts generated under three alternative air cargo price scenarios and two alternative real GNP forecasts. These forecasts assume a domestic all-cargo average haul of 1680 miles and a domestic passenger/cargo average haul of 1135 miles. The forecasts assume that each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period. The forecasts also assume that each airport's all-cargo tons enplaned market share remains unchanged throughout the forecast period.

TABLE 3.7.14 TOTAL DOMESTIC AIR CARGO ENPLANED FORECAST, CASE 3
(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	394942	453913	599393	765531
LAX	LOS ANGELES, CALIF.	334384	368058	468220	579282
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	236128	272508	361076	462450
SFO	SAN FRANCISCO, CALIF.	191762	215432	279044	350673
ATL	ATLANTA, GA.	140776	155187	197686	244869
SEA	SEATTLE, WASH.	107178	120104	155226	194707
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	127547	150091	202026	262053
DFW	DALLAS/FT. WORTH, TEXAS	96445	100169	120580	141707
HNL	HONOLULU, OAHU, HAWAII	67684	68520	80329	91918
BOS	BOSTON, MASS.	75197	87241	116096	149215
DEN	DENVER, COLORADO	68984	69836	81872	93624
MIA	MIAMI, FLORIDA	56054	60154	74758	90563
CLE	CLEVELAND, OHIO	48789	56011	73893	94301
PHL	PHILADELPHIA, PA.	51622	57864	74805	93852
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	43890	51455	58878
IAH	HOUSTON, TEXAS	52279	57936	74151	92230
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	42814	50193	57435
ANC	ANCHORAGE, ALASKA	85885	115481	170860	237533
STL	ST. LOUIS, MO.	29360	29723	34845	39872
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	28794	33757	38627
ITO	HILO, HAWAII, HAWAII	18179	18404	21575	24688
MEM	MEMPHIS, TENN.	21082	21342	25021	28630
PDX	PORTLAND, OREGON	23546	24058	28478	32912
MCI	KANSAS CITY, MO.	20866	21144	24789	28364
PIT	PITTSBURGH, PA.	20234	20484	24014	27479
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	19217	22529	25780
IND	INDIANAPOLIS, IND.	18160	18389	21565	24684
BAL	BALTIMORE, MD.	17067	17278	20255	23178
TPA	TAMPA, FLORIDA	15747	15941	18689	21385
DAY	DAYTON, OHIO	13764	13934	16335	18692
MSY	NEW ORLEANS, LA.	13918	14090	16518	18901
CLT	CHARLOTTE, N.C.	19164	22139	29358	37626
PHX	PHOENIX, ARIZ.	16053	16252	19053	21803
BDL	HARTFORD, CONN.	17023	17233	20203	23118
MKE	MILWAUKEE, WIS.	9605	9724	11399	13044
BUF	BUFFALO, N.Y.	13250	13435	15776	18083
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	9254	10849	12414
SYR	SYRACUSE, N.Y.	10175	13442	19664	27127

NOTES ON TABLE 3.7.14

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 5, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

  Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

  Domestic all-cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

- Forecast assumes each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

  Forecast assumes each airport's 1978 all-cargo tons enplaned market share remains unchanged throughout the forecast period.

TABLE 3.7.15 TOTAL DOMESTIC AIR CARGO ENPLANED FORECAST, CASE 4
(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	394942	472926	687181	954735
LAX	LOS ANGELES, CALIF.	334384	385083	543254	735786
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	236128	283911	413514	575826
SFO	SAN FRANCISCO, CALIF.	191762	224947	321884	441414
ATL	ATLANTA, GA.	140776	162341	229265	310810
SEA	SEATTLE, WASH.	107178	125439	179184	245354
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	127547	156031	230226	323951
DFW	DALLAS/FT. WORTH, TEXAS	96445	105421	142482	185488
HNL	HONOLULU, OAHU, HAWAII	67684	72307	95776	122240
BOS	BOSTON, MASS.	75197	90815	132775	185424
DEN	DENVER, COLORADO	68984	73696	97616	124588
MIA	MIAMI, FLORIDA	56054	63096	87403	116447
CLE	CLEVELAND, OHIO	48789	58363	84740	117660
PHL	PHILADELPHIA, PA.	51622	60433	86343	118250
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	46317	61349	78301
IAH	HOUSTON, TEXAS	52279	60575	85865	116787
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	45181	59845	76381
ANC	ANCHORAGE, ALASKA	85885	118658	189222	282483
STL	ST. LOUIS, MO.	29360	31366	41546	53025
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	30386	40248	51369
ITO	HILO, HAWAII, HAWAII	18179	19421	25724	32832
MEM	MEMPHIS, TENN.	21082	22522	29832	38075
PDX	PORTLAND, OREGON	23546	25363	33842	43510
MCI	KANSAS CITY, MO.	20886	22313	29555	37721
PIT	PITTSBURGH, PA.	20234	21616	28632	36543
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	20280	26862	34284
IND	INDIANAPOLIS, IND.	18160	19405	25709	32820
BAL	BALTIMORE, MD.	17067	18233	24151	30824
TPA	TAMPA, FLORIDA	15747	16823	22283	28440
DAY	DAYTON, OHIO	13764	14704	19477	24858
MSY	NEW ORLEANS, LA.	13918	14869	19695	25136
CLT	CHARLOTTE, N.C.	19164	23055	33613	46832
PHX	PHOENIX, ARIZ.	16053	17150	22717	28995
BDL	HARTFORD, CONN.	17023	18186	24088	30744
MKE	MILWAUKEE, WIS.	9605	10261	13592	17347
BUF	BUFFALO, N.Y.	13250	14175	18799	24023
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	9765	12935	16509
SYR	SYRACUSE, N.Y.	10175	13832	21850	32398

NOTES ON TABLE 3.7.15

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

  Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

  Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

- Forecast assumes each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

  Forecast assumes each airport's 1978 all-cargo tons enplaned market share remains unchanged througout the forecast period.

TABLE 3.7.16 TOTAL DOMESTIC AIR CARGO ENPLANED FORECAST, CASE 5
(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	394942	482610	729942	1044083
LAX	LOS ANGELES, CALIF.	334384	394099	582160	815553
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	236128	289545	438893	628961
SFO	SAN FRANCISCO, CALIF.	191762	229898	343472	486054
ATL	ATLANTA, GA.	140776	166125	245606	344333
SEA	SEATTLE, WASH.	107178	128221	191300	270381
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	127547	158983	243454	351919
DFW	DALLAS/FT. WORTH, TEXAS	96445	108322	154699	210012
HNL	HONOLULU, OAHU, HAWAII	67684	74433	104646	139901
BOS	BOSTON, MASS.	75197	92617	140781	202229
DEN	DENVER, COLORADO	68984	75862	106655	142589
MIA	MIAMI, FLORIDA	56054	64685	94182	130211
CLE	CLEVELAND, OHIO	48789	59562	90033	128713
PHL	PHILADELPHIA, PA.	51622	61773	92176	130299
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	47678	67031	89614
IAH	HOUSTON, TEXAS	52279	61965	91883	129159
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	46509	65387	87417
ANC	ANCHORAGE, ALASKA	85885	119921	195733	297662
STL	ST. LOUIS, MO.	29360	32287	45393	60687
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	31279	43975	58791
ITO	HILO, HAWAII, HAWAII	18179	19992	28106	37576
MEM	MEMPHIS, TENN.	21082	23184	32595	43576
PDX	PORTLAND, OREGON	23546	26091	36891	49599
MCI	KANSAS CITY, MO.	20886	22969	32292	43171
PIT	PITTSBURGH, PA.	20234	22252	31284	41823
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	20876	29349	39237
IND	INDIANAPOLIS, IND.	18160	19975	28088	37558
BAL	BALTIMORE, MD.	17067	18769	26387	35277
TPA	TAMPA, FLORIDA	15747	17317	24346	32549
DAY	DAYTON, OHIO	13764	15136	21280	28450
MSY	NEW ORLEANS, LA.	13918	15306	21518	28768
CLT	CHARLOTTE, N.C.	19164	23519	35669	51139
PHX	PHOENIX, ARIZ.	16053	17654	24821	33183
BDL	HARTFORD, CONN.	17023	18720	26319	35186
MKE	MILWAUKEE, WIS.	9605	10563	14950	19853
BUF	BUFFALO, N.Y.	13250	14590	20532	27475
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	10052	14133	18894
SYR	SYRACUSE, N.Y.	10175	13994	22661	34257

NOTES ON TABLE 3.7.16

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

  Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Forecast assumes each airport's 1978 passenger/cargo tons enplanes market share remains unchanged throughout the forecast period.

  Forecast assumes each airport's 1978 all-cargo tons enplanes market share remains unchanged throughout the forecast period.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually.

  Domestic all-cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

TABLE 3.7.17 TOTAL DOMESTIC AIR CARGO ENPLANED FORECAST, CASE 6
(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	394942	459889	653372	836515
LAX	LOS ANGELES, CALIF.	334384	372992	508147	629362
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	236128	276089	393747	505582
SFO	SAN FRANCISCO, CALIF.	191762	218295	303489	382080
ATL	ATLANTA, GA.	140776	157265	214578	266097
SEA	SEATTLE, WASH.	107178	121701	168781	212073
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	127547	152048	220702	287134
DFW	DALLAS/FT. WORTH, TEXAS	96445	101545	129968	152440
HNL	HONOLULU, OAHU, HAWAII	67684	69472	86206	98342
BOS	BOSTON, MASS.	75197	88385	126663	163243
DEN	DENVER, COLORADO	68984	70807	87943	100259
MIA	MIAMI, FLORIDA	56054	60969	80902	98084
CLE	CLEVELAND, OHIO	48789	56748	80538	103651
PHL	PHILADELPHIA, PA.	51622	58634	81340	102237
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	44500	55270	63019
IAH	HOUSTON, TEXAS	52279	58710	80533	100301
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	43409	53915	61465
ANC	ANCHORAGE, ALASKA	85885	116910	188557	263307
STL	ST. LOUIS, MO.	29360	30136	37429	42671
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	29194	36260	41338
ITO	HILO, HAWAII, HAWAII	18179	18659	23175	26421
MEM	MEMPHIS, TENN.	21082	21639	26876	30640
PDX	PORTLAND, OREGON	23546	24391	30629	35292
MCI	KANSAS CITY, MO.	20886	21438	26626	30355
PIT	PITTSBURGH, PA.	20234	20769	25795	29407
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	19485	24200	27589
IND	INDIANAPOLIS, IND.	18160	18645	23165	26418
BAL	BALTIMORE, MD.	17067	17518	21758	24804
TPA	TAMPA, FLORIDA	15747	16163	20075	22886
DAY	DAYTON, OHIO	13764	14128	17547	20004
MSY	NEW ORLEANS, LA.	13918	14286	17743	20228
CLT	CHARLOTTE, N.C.	19164	22429	32017	41140
PHX	PHOENIX, ARIZ.	16053	16478	20466	23333
BDL	HARTFORD, CONN.	17023	17473	21701	24741
MKE	MILWAUKEE, WIS.	9605	9859	12245	13960
BUF	BUFFALO, N.Y.	13250	13621	16949	19358
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	9383	11653	13285
SYR	SYRACUSE, N.Y.	10175	13609	21675	30033

NOTES ON TABLE 3.7.17

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

  Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Forecast assumes each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

  Forecast assumes each airport's 1978 all-cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile increases 2% annually.

  Domestic all-cargo 1972 dollar average revenue per ton-mile yield increases 2% annually.

TABLE 3.7.18 TOTAL DOMESTIC AIR CARGO ENPLANED FORECAST, CASE 7
(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	394942	479070	746383	1037748
LAX	LOS ANGELES, CALIF.	334384	390165	587178	794518
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	236128	287493	449337	626255
SFO	SAN FRANCISCO, CALIF.	191762	227894	348736	478193
ATL	ATLANTA, GA.	140776	164482	247846	335703
SEA	SEATTLE, WASH.	107178	127083	194076	265695
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	127547	158041	250680	353346
DFW	DALLAS/FT. WORTH, TEXAS	96445	106842	152867	198171
HNL	HONOLULU, OAHU, HAWAII	67684	73292	102386	129878
BOS	BOSTON, MASS.	75197	91991	144358	201810
DEN	DENVER, COLORADO	68984	74699	104353	132373
MIA	MIAMI, FLORIDA	56054	63937	94177	125195
CLE	CLEVELAND, OHIO	48789	59121	92029	127870
PHL	PHILADELPHIA, PA.	51622	61225	93523	128058
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	46947	65584	83193
IAH	HOUSTON, TEXAS	52279	61373	92882	126248
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	45796	63976	81154
ANC	ANCHORAGE, ALASKA	85885	120119	208493	312455
STL	ST. LOUIS, MO.	29360	31792	44413	56339
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	30800	43026	54579
ITO	HILO, HAWAII, HAWAII	18179	19685	27500	34884
MEM	MEMPHIS, TENN.	21082	22929	31891	40454
PDX	PORTLAND, OREGON	23546	25707	36226	46325
MCI	KANSAS CITY, MO.	20886	22616	31594	40078
PIT	PITTSBURGH, PA.	20234	21910	30608	38827
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	20556	28716	36426
IND	INDIANAPOLIS, IND.	18160	19669	27485	34873
BAL	BALTIMORE, MD.	17067	18481	25817	32750
TPA	TAMPA, FLORIDA	15747	17052	23821	30217
DAY	DAYTON, OHIO	13764	14904	20821	26412
MSY	NEW ORLEANS, LA.	13918	15071	21054	26707
CLT	CHARLOTTE, N.C.	19164	23354	36529	50941
PHX	PHOENIX, ARIZ.	16053	17383	24285	30807
BDL	HARTFORD, CONN.	17023	18433	25751	32665
MKE	MILWAUKEE, WIS.	9605	10401	14530	18431
BUF	BUFFALO, N.Y.	13250	14368	20101	25533
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	9898	13828	17541
SYR	SYRACUSE, N.Y.	10175	14003	24041	35779

NOTES ON TABLE 3.7.18

- Forecasts utilizes 1972 dollar GNP values from Wharton's annual model, December 5, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

  Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Forecast assumes each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

  Forecast assumes each airport's 1978 all-cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

  Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

TABLE 3.7.19 TOTAL DOMESTIC AIR CARGO ENPLANED FORECAST, CASE 8
(tons)

Airport Code	City/State	1978	1980	1985	1990
ORD	CHICAGO, ILL. (OHARE AIRPORT)	394942	488834	791205	1131434
LAX	LOS ANGELES, CALIF.	334384	399254	627933	877769
JFK	NEW YORK, N.Y. (KENNEDY INT'L AIRPORT)	236128	293274	475949	681997
SFO	SAN FRANCISCO, CALIF.	191762	232885	371326	524882
ATL	ATLANTA, GA.	140776	168277	264924	370695
SEA	SEATTLE, WASH.	107178	129889	206752	291863
DTW	DETROIT, MICH. (METROPOLITAN AIRPORT)	127547	161018	264573	382657
DFW	DALLAS/FT. WORTH, TEXAS	96445	109767	165590	223631
HNL	HONOLULU, OAHU, HAWAII	67684	75434	111611	148175
BOS	BOSTON, MASS.	75197	93806	152757	219450
DEN	DENVER, COLORADO	68984	76883	113755	151021
MIA	MIAMI, FLORIDA	56054	65538	101250	139524
CLE	CLEVELAND, OHIO	48789	60331	97577	139458
PHL	PHILADELPHIA, PA.	51622	62576	99625	140658
MSP	MINNEAPOLIS/ST. PAUL, MINN.	43355	48319	71492	94914
IAH	HOUSTON, TEXAS	52279	62774	99173	139169
EWR	NEW YORK, N.Y. (NEWARK AIRPORT)	42292	47134	69740	92587
ANC	ANCHORAGE, ALASKA	85885	121394	215446	328773
STL	ST. LOUIS, MO.	29360	32722	48415	64276
LGA	NEW YORK, N.Y. (LA GUARDIA AIRPORT)	28443	31700	46903	62269
ITO	HILO, HAWAII, HAWAII	18179	20260	29977	39798
MEM	MEMPHIS, TENN.	21082	23496	34764	46153
PDX	PORTLAND, OREGON	23546	26441	39399	52636
MCI	KANSAS CITY, MO.	20886	23277	34441	45724
PIT	PITTSBURGH, PA.	20234	22551	33366	44297
DCA	WASHINGTON, D.C. (NATIONAL AIRPORT)	18983	21157	31303	41558
IND	INDIANAPOLIS, IND.	18160	20244	29959	39781
BAL	BALTIMORE, MD.	17067	19021	28143	37363
TPA	TAMPA, FLORIDA	15747	17550	25967	34474
DAY	DAYTON, OHIO	13764	15340	22697	30132
MSY	NEW ORLEANS, LA.	13918	15512	22951	30470
CLT	CHARLOTTE, N.C.	19164	23822	38685	55459
PHX	PHOENIX, ARIZ.	16053	17892	26473	35146
BDL	HARTFORD, CONN.	17023	18972	28071	37267
MKE	MILWAUKEE, WIS.	9605	10705	15839	21027
BUF	BUFFALO, N.Y.	13250	14786	21903	29110
IAD	WASHINGTON, D.C. (DULLES AIRPORT)	9141	10188	15074	20012
SYR	SYRACUSE, N.Y.	10175	14166	24905	37770

NOTES ON TABLE 3.7.19

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%).

- Forecast assumes a domestic passenger/cargo average haul of 1135 miles.

  Forecast assumes a domestic all-cargo average haul of 1680 miles.

- Forecast assumes each airport's 1978 passenger/cargo tons enplaned market share remains unchanged throughout the forecast period.

  Forecast assumes each airport's 1978 all-cargo tons enplaned market share remains unchanged throughout the forecast period.

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually.

  Domestic all-cargo 1972 dollar average per ton-mile yield declines 4.% annually.

4. INTERNATIONAL AIR CARGO FORECASTS

4.1 Introduction

This section presents the empirical models, data sources and forecasts of international air cargo. These models are econometric analyses of cargo flows for six world regions, defined by the Commerce Department, with historical data covering the period from 1964 to 1977.

Historical information for international air cargo was obtained from U.S. Department of Commerce publications which define both total air shipments and shipments by U.S. flag air carriers.

Forecasts are presented in a format consistent with the historical information. Models were constructed for total air cargo and for U.S. flag air cargo shipment to and from each of the six world regions, twenty-four models in all.

Forecasts of shipments through each of a selected number of "major hubs" are presented along with the aggregate tonnage forecasts.

Conversion from the tonnage forecasts to ton-mile forecasts are made on an ad hoc basis and are presented as well. The remainder of this section is organized as follows:

Section 4.2 reports the historical air cargo trends and displays the data of air cargo tonnages used in this study.

Section 4.3 explains the model structure on which the regression analysis was performed.

Section 4.4 describes both the dependent and independent variables for both the import and export models.

Section 4.5 presents the empirical results of our regression analysis showing the estimated equations and appropriate statistics, as well as the model elasticities.

Section 4.6 provides the cargo forecasts (in thousands of tons) along with a brief description of the variable forecasts.

Section 4.7 explains the method used in proportioning the cargo forecasts among the "major hubs."

Section 4.8 explains the method for converting tonnage forecasts to ton-mile forecasts.

4.2 Historical Growth Trends

The historical data of U.S. international air cargo flows from 1964-1977 is available from the annual issues of U.S. Airborne Exports and General Imports, Foreign Trade Statistics published by the U.S. Department of Commerce. The statistics of exports by air from the United States include exports of domestic and foreign merchandise, government as well as non-government shipments. The statistics exclude the following items: shipments to U.S. Armed Forces and diplomatic missions abroad for their own use; merchandise shipped through the United States from one foreign country to another when documented as such through U.S. Customs; exports of household and personal effects; shipments by mail and parcel post; and, shipments of airplanes under their own power.

The statistics on imports by air to the U.S. include government as well as non-government shipments of merchandise by air from foreign countries to the U.S. Imports into Puerto Rico from foreign countries are considered to be U.S. imports and are included. The items excluded from the import statistics are: U.S. trade with Puerto Rico and U.S. possessions and trade between U.S. possessions; merchandise shipped through the United States in transit from one foreign country to another when documented as such through U.S. Customs; imports of household and personal effects; and imports of airplanes under their own power.

The statistics of U.S. exports and imports by air are aggregations of flows between the U.S. and six world regions. They are also aggregations of all carriers serving U.S. airports and the subset of U.S. flag carriers. Foreign flag activity is available, therefore, only as a residual. The six world regions are: North America excluding U.S., South America, Europe, Asia, Australia and Oceania and Africa.

Statistics of air cargo flow for these six regions have been compiled and are displayed in Tables 4.2.1 to 4.2.5. Growth of air carrier shipments has been impressive, showing nearly an eight-fold increase over the fourteen year period for which data has been collected. Rates of growth in each of the regions have marked the air cargo market as one of large potential which is likely to continue into the future. The aggregate flow for the combined six regions has increased from just under two hundred thousand tons to just over one and a half million tons annually.

The largest absolute growth of air cargo has been with the European region. Total air cargo has grown from 83,122 tons to 614,725 tons between 1964 to 1977. Next to Europe, Asia has had the largest absolute air cargo growth, increasing from 14,832 tons in 1964 to 391,747 tons in 1977. Together these two regions comprised 65 percent of the air cargo shipments to and from the U.S. in 1977.

TABLE 4.2.1

TOTAL U.S. AIR CARGO FLOWS BY ALL AIR CARRIERS BY CONTINENT (1964-1977)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	61.89	35.092	83.122	14.833	1.602	2.371	198.911
1965	80.214	45.583	146.77	27.924	2.698	4.087	307.278
1966	87.042	43.288	170.355	38.102	3.246	4.623	346.658
1967	101.07	45.253	214.108	53.047	4.948	5.907	424.333
1968	127.177	49.606	278.522	70.714	7.692	8.228	541.94
1969	152.124	65.096	399.589	99.757	8.89	11.627	737.083
1970	154.839	69.421	391.314	119.359	9.675	10.726	755.335
1971	160.278	85.061	423.232	169.601	11.64	12.417	894.983
1972	177.397	104.75	491.996	201.776	12.681	12.805	1001.41
1973	201.5	128.516	580.698	240.153	18.247	15.55	1184.67
1974	232.397	168.287	614.545	256.804	23.83	22.499	1318.36
1975	216.872	157.064	502.663	311.22	20.553	25.097	1233.47
1976	240.529	153.446	523.147	380.189	22.869	25.655	1345.84
1977	283.616	200.179	614.725	391.747	25.409	30.023	1545.7

TABLE 4.2.2

U.S. EXPORTS BY ALL AIR CARRIERS BY CONTINENT (1964-1977)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	46.394	27.896	48.935	7.94	1.467	2.045	134.678
1965	63.656	35.673	91.019	14.566	2.512	3.705	211.133
1966	67.633	35.595	103.197	18.525	2.896	4.024	231.871
1967	76.165	35.629	124.88	25.793	4.279	5.182	271.928
1968	91.907	38.959	151.583	30.624	6.532	7.31	326.916
1969	106.957	50.371	211.057	44.081	7.248	10.484	430.199
1970	112.258	47.768	214.471	53.742	7.993	9.432	445.665
1971	113.538	50.911	203.115	62.318	9.19	10.992	482.817
1972	126.547	63.597	247.964	78.142	9.577	10.285	536.114
1973	143.051	75.19	323.901	113.24	15.089	13.647	684.118
1974	161.242	104.213	359.551	126.013	20.057	19.495	790.572
1975	146.29	98.084	296.103	122.832	17.2	22.209	702.719
1976	166.047	96.537	292.04	144.397	18.364	22.775	740.159
1977	193.811	136.633	344.461	169.011	19.995	26.962	890.873

TABLE 4.2.3

U.S. EXPORTS BY U.S. FLAG AIR CARRIERS BY CONTINENT (1964-1977)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	21.107	5.715	17.454	4.432	0.41	0.832	49.951
1965	28.24	9.605	31.902	7.559	0.562	1.468	79.337
1966	32.351	9.742	33.33	8.579	0.684	1.425	86.112
1967	35.428	10.11	39.083	11.019	1.047	1.175	97.863
1968	44.896	13.929	50.79	12.65	1.829	1.941	126.035
1969	53.003	17.128	74.845	18.051	1.52	2.507	167.055
1970	45.973	16.502	72.874	22.175	1.468	1.9	160.894
1971	46.159	16.658	67.392	27.68	2.493	2.362	162.745
1972	49.583	19.456	76.361	33.824	2.365	1.799	183.39
1973	58.426	24.436	105.277	45.489	4.176	3.369	241.175
1974	61.098	32.141	122.1	47.568	5.942	4.981	273.832
1975	54.809	30.721	97.567	43.361	4.882	5.086	236.427
1976	68.268	32.217	89.809	48.156	5.873	5.918	250.242
1977	72.842	47.677	96.599	58.559	7.485	6.85	290.014

TABLE 4.2.4

U.S. IMPORTS BY ALL AIR CARRIERS BY CONTINTENT (1964-1977)

(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	15.496	7.196	34.187	6.892	0.135	0.326	64.233
1965	16.558	9.91	55.751	13.357	0.186	0.382	96.145
1966	19.409	7.693	67.158	19.577	0.35	0.599	114.787
1967	24.905	9.624	89.228	27.254	0.669	0.724	152.405
1968	35.27	10.647	126.939	40.09	1.16	0.918	215.024
1969	45.166	14.725	188.531	55.676	1.642	1.142	306.884
1970	42.581	21.653	176.843	65.616	1.682	1.294	309.67
1971	46.74	34.15	220.117	107.283	2.45	1.425	412.166
1972	50.85	41.152	244.032	123.634	3.103	2.52	465.292
1973	58.449	53.326	256.797	126.913	3.158	1.903	500.547
1974	71.154	64.074	254.993	130.79	3.772	3.004	527.789
1975	70.582	58.98	206.56	188.388	3.353	2.888	530.75
1976	74.482	56.909	231.107	235.792	4.505	2.88	605.677
1977	89.805	63.546	270.264	222.736	5.414	3.061	654.826

TABLE 4.2.5

U.S. IMPORTS BY U.S. FLAG AIR CARRIERS BY CONTINENT (1964-1977)

(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	6.714	1.959	16.056	4.683	2.2000E-02	0.136	29.571
1965	7.867	3.218	27.812	8.796	3.6000E-02	0.132	47.861
1966	9.	2.818	30.551	12.891	0.17	0.208	55.64
1967	9.829	3.624	32.894	16.347	0.125	0.156	62.977
1968	17.496	4.547	50.928	25.781	0.38	0.258	99.391
1969	19.936	5.764	78.999	33.473	0.384	0.296	138.853
1970	19.503	9.218	74.244	40.344	0.461	0.351	144.122
1971	19.453	15.233	90.32	61.497	0.904	0.346	187.755
1972	20.24	18.283	97.114	69.717	1.85	0.955	208.161
1973	24.944	22.114	105.625	66.83	1.514	0.382	221.409
1974	26.035	22.439	107.869	62.956	1.717	0.702	221.719
1975	25.305	22.9	84.283	93.719	1.217	0.776	228.201
1976	25.536	19.295	87.6	116.951	1.58	0.42	251.383
1977	35.001	15.769	97.837	114.099	2.46	0.647	265.815

Regional shares for each area were calculated and are displayed in Tables 4.2.6 to 4.2.9 for exports and imports by U.S. flag and all carriers. It is apparent from these tables that over the historical period regional shares have changed dramatically indicating significant differences in the growth of air cargo shipments between regions.

Tables 4.2.10 to 4.2.12 display the growth rates for each of these regions for selected intervals. Because of the present level of trade, growth of Asian traffic is by far the most impressive. Though Africa and Australia/Oceania have shown very high growth rates over the period, the absolute level of trade with these regions started from a very small base. Thus, current cargo shipments by air from each of these regions constitutes less than two percent of total air cargo. It should also be noted that air imports, on average, have been growing at faster rates than exports. This has caused a shift in the amount of return traffic from these regions.

Tables 4.2.13 and 4.2.14 demonstrate the changing ratio of imports to exports, expressed as the percent of imports relative to exports.

TABLE 4.2.6

DISTRIBUTION OF EXPORTS BY ALL AIR CARRIERS BY CONTINENT (1964-1967)
(Percent of Total Export Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	34.45	20.71	36.33	5.9	1.09	1.52	100.
1965	30.15	16.9	43.11	6.9	1.19	1.76	100.
1966	29.17	15.35	44.51	7.99	1.25	1.74	100.
1967	28.01	13.1	45.92	9.49	1.57	1.91	100.
1968	28.11	11.92	46.37	9.37	2.	2.24	100.
1969	24.86	11.71	49.06	10.25	1.68	2.44	100.
1970	25.19	10.72	48.12	12.06	1.79	2.12	100.
1971	23.52	10.54	42.07	12.91	1.9	2.28	100.
1972	23.6	11.86	46.25	14.58	1.79	1.92	100.
1973	20.91	10.99	47.35	16.55	2.21	1.99	100.
1974	20.4	13.18	45.48	15.94	2.54	2.47	100.
1975	20.82	13.96	42.14	17.48	2.45	3.16	100.
1976	22.43	13.04	39.46	19.51	2.48	3.08	100.
1977	21.76	15.34	38.67	18.97	2.24	3.03	100.

TABLE 4.2.7

DISTRIBUTION OF U.S. EXPORTS BY U.S. FLAG AIR CARRIERS BY CONTINENT (1964-1977)

(Percent of Total U.S. Flag Export Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	42.26	11.44	34.94	8.87	0.82	1.67	100.
1965	35.6	12.11	40.21	9.53	0.71	1.85	100.
1966	37.57	11.31	38.71	9.96	0.79	1.65	100.
1967	36.2	10.33	39.94	11.26	1.07	1.2	100.
1968	35.62	11.05	40.3	10.04	1.45	1.54	100.
1969	31.73	10.25	44.8	10.81	0.91	1.5	100.
1970	28.57	10.26	45.29	13.78	0.91	1.18	100.
1971	28.36	10.24	41.41	17.01	1.53	1.45	100.
1972	27.04	10.61	41.64	18.44	1.29	0.98	100.
1973	24.23	10.13	43.65	18.86	1.73	1.4	100.
1974	22.31	11.74	44.59	17.37	2.17	1.82	100.
1975	23.18	12.99	41.27	18.34	2.07	2.15	100.
1976	27.28	12.87	35.89	19.24	2.35	2.36	100.
1977	25.12	16.44	33.31	20.19	2.58	2.36	100.

TABLE 4.2.8

DISTRIBUTION OF IMPORTS BY ALL AIR CARRIERS BY CONTINENT (1964-1977)

(Percent of Total Import Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	24.13	11.2	53.22	10.73	0.21	0.51	100.
1965	17.22	10.31	57.99	13.89	0.19	0.4	100.
1966	16.91	6.7	58.51	17.06	0.31	0.52	100.
1967	16.34	6.32	58.55	17.88	0.44	0.48	100.
1968	16.4	4.95	59.03	18.64	0.54	0.43	100.
1969	14.72	4.8	61.43	18.14	0.54	0.37	100.
1970	13.75	6.99	57.11	21.19	0.54	0.42	100.
1971	11.34	8.29	53.4	26.03	0.59	0.35	100.
1972	10.93	8.84	52.45	26.57	0.67	0.54	100.
1973	11.68	10.65	51.3	25.35	0.63	0.38	100.
1974	13.48	12.14	48.31	24.78	0.71	0.57	100.
1975	13.3	11.11	38.92	35.49	0.63	0.54	100.
1976	12.3	9.4	38.16	38.93	0.74	0.48	100.
1977	13.71	9.7	41.27	34.01	0.83	0.47	100.

TABLE 4.2.9

DISTRIBUTION OF U.S. IMPORTS BY U.S. FLAG AIR CARRIERS BY CONTINENT (1964-1977)

(Perent of Total U.S. Import Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	22.7	6.63	54.3	15.84	0.07	0.46	100.
1965	16.44	6.72	58.11	18.38	0.08	0.28	100.
1966	16.18	5.07	54.91	23.17	0.31	0.37	100.
1967	15.61	5.76	52.23	25.96	0.2	0.25	100.
1968	17.6	4.57	51.24	25.94	0.38	0.26	100.
1969	14.36	4.15	56.89	24.11	0.28	0.21	100.
1970	13.53	6.4	51.51	27.99	0.32	0.24	100.
1971	10.36	8.11	48.11	32.75	0.48	0.18	100.
1972	9.72	8.78	46.65	33.49	0.89	0.46	100.
1973	11.27	9.99	47.71	30.18	0.68	0.17	100.
1974	11.74	10.12	48.65	28.39	0.77	0.32	100.
1975	11.09	10.04	36.93	41.07	0.53	0.34	100.
1976	10.16	7.68	34.85	46.52	0.63	0.17	100.
1977	13.17	5.93	36.81	42.92	0.93	0.24	100.

TABLE 4.2.10

HISTORICAL GROWTH RATES OF TOTAL CARGO FLOWS BY ALL AIR CARRIERS (1964-1977)

(Average Annual Compounded Growth Rates)

(percent)

	North America	South America	Europe	Asia	Australia & Oceania	Africa	Total
1964-1967	17.76	8.85	37.08	52.92	45.63	35.56	28.73
1967-1970	15.28	15.33	22.26	31.04	25.05	22.00	21.19
1970-1973	9.19	22.79	14.06	26.24	23.55	13.18	16.19
1973-1977	8.92	11.72	1.43	13.01	8.63	17.88	6.88
1964-1977	11.49	13.24	15.36	26.34	21.83	19.88	15.77

TABLE 4.2.11

HISTORICAL GROWTH RATES OF TOTAL U.S. AIR CARGO BY AIR

ALL CARRIERS

EXPORTS

(percent)

	North America	South America	Europe	Asia	Australia & Oceania	Africa	Total
1964-1967	17.97	8.50	36.65	48.10	52.30	36.33	26.39
1967-1970	13.80	10.27	19.75	27.72	15.54	22.10	17.90
1970-1973	8.42	16.33	14.73	28.20	23.59	13.10	15.36
1973-1977	7.89	16.10	1.55	10.53	7.29	18.56	6.82
1964-1977	10.75	12.02	14.96	24.41	20.51	20.23	14.45

IMPORTS

1964-1967	17.14	10.18	37.68	58.14	70.49	30.47	33.38
1967-1970	19.58	31.04	25.61	34.03	35.98	21.36	26.66
1970-1973	11.14	35.04	13.24	24.59	23.37	13.72	17.36
1973-1977	11.33	4.48	1.29	15.10	14.43	12.62	6.95
1964-1977	13.37	16.83	15.91	28.18	30.17	17.35	18.04

TABLE 4.2.12

HISTORICAL GROWTH RATES OF U.S. FLAG CARRIERS AIR CARGO SHIPMENTS

EXPORTS

(percent)

	North America	South America	Europe	Asia	Australia & Oceania	Africa	Total
1964-1967	18.84	20.94	30.83	35.47	36.69	12.19	25.13
1967-1970	9.07	17.74	23.08	26.25	11.92	17.37	18.02
1970-1973	8.32	13.98	13.05	27.06	41.69	21.04	14.45
1973-1977	5.67	18.19	-2.13	6.52	15.71	19.41	4.72
1964-1977	9.25	16.36	13.00	20.25	23.06	16.25	13.39

IMPORTS

1964-1967	13.55	22.76	27.01	51.70	78.44	4.68	28.66
1967-1970	25.66	36.51	31.17	35.14	54.50	31.04	31.78
1970-1973	8.55	33.87	12.47	18.32	48.64	2.81	15.39
1973-1977	8.84	-8.11	-1.90	14.31	12.90	14.08	4.68
1964-1977	12.52	16.06	13.78	25.62	40.06	11.78	16.98

TABLE 4.2.13

U.S. IMPORTS AS RATIO OF TOTAL U.S. EXPORTS FOR ALL AIR CARRIERS BY CONTINENT
(1964-1977)
(percent)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	33.402	25.795	69.862	86.802	9.202	15.966	47.694
1965	26.012	27.782	61.252	91.7	7.403	10.309	45.538
1966	28.697	21.613	65.078	105.676	12.103	14.884	49.505
1967	32.699	27.013	71.451	105.664	15.646	13.98	56.046
1968	38.376	27.329	83.742	130.908	17.766	12.557	65.774
1969	42.228	29.234	89.327	126.305	22.655	10.897	71.335
1970	37.931	45.331	82.455	122.094	21.042	13.725	69.485
1971	41.167	67.079	108.371	172.155	26.658	12.969	85.367
1972	40.183	64.708	98.414	158.216	32.404	24.5	86.79
1973	40.859	70.922	79.282	112.074	20.928	13.948	73.167
1974	44.129	61.484	70.92	103.791	18.808	15.409	66.76
1975	48.248	60.132	69.759	153.37	19.494	13.003	75.528
1976	44.856	58.95	79.136	163.295	24.534	12.648	81.831
1977	46.336	46.509	78.46	131.788	27.077	11.353	73.504

TABLE 4.2.14

U.S IMPORTS BY FLAG AIR CARRIERS AS RATIO OF TOTAL U.S. EXPORTS BY FLAG AIR CARRIERS BY CONTINENT

(1964-1977)

(percent)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	31.809	34.287	91.993	105.651	5.359	16.406	59.201
1965	27.857	33.502	87.181	116.357	6.406	8.992	60.326
1966	27.821	28.931	91.662	150.262	24.909	14.632	64.614
1967	27.744	35.851	84.166	148.351	11.981	13.277	64.352
1968	38.97	32.644	100.273	203.802	20.804	13.318	78.86
1969	37.613	33.655	105.549	185.438	25.255	11.805	83.118
1970	42.423	55.863	101.879	181.931	31.403	18.495	89.576
1971	42.145	91.446	134.022	222.173	36.282	14.667	115.368
1972	40.821	93.971	127.177	206.114	78.245	53.098	113.507
1973	42.693	90.498	100.33	146.913	36.25	11.337	91.804
1974	42.612	69.813	88.345	132.349	28.894	14.102	80.969
1975	46.169	74.542	86.384	216.137	24.936	15.267	96.52
1976	37.405	59.89	97.54	242.857	26.903	7.105	100.456
1977	48.05	33.075	101.282	194.844	32.866	9.453	91.656

Another implication of Tables 4.2.11 and 4.2.12 is that the U.S. flag carrier share of trade has not grown as fast as total air trade. Therefore, a relative decline in the U.S. air carrier's share of air cargo has occurred. Tables 4.2.15 and 4.2.16 displays this trend. From these tables one can see the particular markets where U.S. flag carriers have fared better or worse than their competitors. These historical trends mark the historical market structure.

Following is a more detailed view of air exports and imports taken separately.

TABLE 4.2.15

EXPORTS BY U.S. FLAG AIR CARRIERS AS RATIO OF TOTAL U.S. EXPORTS BY ALL AIR CARRIERS BY CONTINENT
(1964-1977)
(percent)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	45.495	20.486	35.668	55.821	27.982	40.685	37.089
1965	44.364	26.927	35.05	51.896	22.368	39.617	37.577
1966	47.834	27.369	32.297	46.309	23.636	35.408	37.138
1967	46.515	28.376	31.296	42.723	24.48	22.672	35.989
1968	48.849	35.753	33.506	41.307	28.001	26.551	38.553
1969	49.555	34.004	35.462	40.95	20.978	23.916	38.832
1970	40.953	34.546	33.979	41.262	18.365	20.149	36.102
1971	40.655	32.721	33.179	44.417	27.126	21.493	33.707
1972	39.181	30.593	30.795	43.286	24.693	17.495	34.207
1973	40.843	32.5	32.503	40.171	27.678	24.69	35.253
1974	37.892	30.842	33.959	37.748	29.627	25.553	34.637
1975	37.466	31.321	32.95	35.301	28.386	22.9	33.645
1976	41.114	33.373	30.752	33.35	31.981	25.985	33.809
1977	37.584	34.895	28.044	34.648	37.434	25.406	32.554

TABLE 4.2.16

IMPORTS BY U.S. FLAG AIR CARRIERS AS RATIO OF TOTAL U.S. IMPORTS BY ALL AIR CARRIERS BY CONTINENT
(1964-1977)
(percent)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1964	43.326	27.23	46.967	67.943	16.296	41.807	46.038
1965	47.51	32.471	49.887	65.851	19.355	34.555	49.78
1966	46.373	36.637	45.491	65.848	48.645	34.808	48.472
1967	39.466	37.659	36.866	59.982	18.745	21.532	41.322
1968	49.606	42.707	40.12	64.308	32.788	28.159	46.223
1969	44.139	39.146	41.902	60.121	23.386	25.908	45.246
1970	45.803	42.573	41.983	61.485	27.408	27.153	46.541
1971	41.621	44.607	41.033	57.322	36.918	24.307	45.553
1972	39.804	44.429	39.796	56.39	59.626	37.917	44.738
1973	42.676	41.47	41.132	52.658	47.942	20.068	44.234
1974	36.59	35.02	42.303	48.135	45.514	23.385	42.009
1975	35.852	38.827	40.803	49.748	36.311	26.887	42.996
1976	34.285	33.905	37.904	49.599	35.068	14.598	41.504
1977	38.974	24.816	36.201	51.226	45.438	21.153	40.593

Within the six regions mentioned above, air exports to Europe have dominated total air cargo shipments throughout the 1964 to 1977 period. Total exports have grown from 48,935 tons in 1964 to 344,461 tons in 1977 with an average annual compounded growth rate of nearly 15 percent. Trade with the regions defined as North America is the second largest trade area in terms of total export tonnage. However, the growth rate of trade with Asia has been the greatest among all regions, with annual growth at a very rapid 24+ percent over the entire historical period. Due to the size of the present export markets, projections of growth rates in the historical ranges will soon make Asia the dominant trade recipient for U.S. air cargo. Total export trade to Asia over the years 1964 through 1977 has grown from 7,940 tons to 169,011 tons. Both Africa and Australia/Oceania have grown at compounded rates of more than 20 percent per annum, but the level from which these areas started was small. Consequently, these two regions currently constitute only 2 to 3 percent of the total export trade each. Trade with South America has fluctuated with the annual compounded growth rate averaging slightly over 12 percent. Total air freight to South America has grown from slightly less than 28,000 tons in 1964 to nearly 137,000 tons by 1977.

Total U.S. air freight exports, as recorded by the U.S. Commerce Department for these areas, has grown from 134,678 to 890,873 tons from 1964 to 1977, a growth rate of 14.45 percent compounded annually.

Exports by U.S. flag carriers have grown at a slightly slower rate of 13.39 percent per annum, from 49,951 tons to 290,014 tons.

The case of U.S. air freight imports is similar to that of exports. Air freight from Europe has been far larger than from any other world area. In fact, until 1973 more air imports came from Europe than from all other areas combined. However, because the growth of air freight from Asia has been nearly twice the rate of that from Europe (28+ percent versus nearly 15 percent from 1964 through 1977), tonnage from Asia is only slightly less than that from Europe. Air freight from Europe grew from 34,187 to 270,264 tons, while air freight from Asia grew from only 6,892 tons to 222,736 tons. At the historical growth rates, Asian import trade would surpass European import trade by 1980.

Growth of imports from Australia and Oceania has been at a faster rate than from Asia but the base is much smaller. Imports by air from North America are in a distant third place, after Asia and Europe, followed then by South America, Australia/Oceania and finally Africa.

The growth of imports carried by U.S. flag airlines has been moderately slower than total air freight imports, (16.98 percent versus 18.04 percent). Consequently the U.S. flag carrier share has fallen from nearly 50 percent of total air imports to just over 40 percent.

4.3 The Model

The model used in this study is based on the assumption that the demand for transportation of imported and exported cargo is a derived demand for service. Transportation services have no intrinsic value in commodity shipments, rather these services are only important because they move goods from points of production to points of final use. Therefore, to model the demand for air freight, one must understand that the amount of air freight shipments is related to the price and quality of available transportation alternatives and the total quantity of goods demanded which, depending upon the characteristics of the goods and transportation alternatives, may either be shipped by air or vessel (except in North America, of course, where some overland transportation occurs).

These relationships can be expressed symbolically as follows:

First, total trade demand might be hypothesized to be related to regional income and the relative price of foreign goods versus, domestic goods. Equation 4.3.1 represents this model:

$$Q_i = f\ (Y_i,\ P_{Oi}) \qquad (4.3.1)$$

where,

Q_i = denotes total trade demand for the i^{th} region

Y_i = aggregate national income for region i

P_{Oi} = relative price of goods to region i from point of origin.

Given the total amount of goods demanded in trade, that portion which will be shipped by air is related to the cost and quality of air freight as well as the cost and quality of alternative modes.

This model is expressed mathematically in equation 4.3.2.

where: $A_i = f\ (Q_i, C, P_{1i}, X_{1i}, X_{2i})$ (4.3.2)

A_i = Quantity of goods shipped by air to region i

Q_i = Total quantity of goods shipped by any mode to region i

C = Characteristics of the various commodities shipped

P_{1i} = Price of air freight services to region i

P_{2i} = Price of competing freight services to region i

X_{1i} = Service quality of air freight transportation to region i

X_{2i} = Service quality of competing freight transportation to region i.

The above models, (4.3.1 and 4.3.2), can be condensed into the following composite form:

$$A_i = h\ (Y_i, P_{Oi}, C, P_{1i}, P_{2i}, X_{1i}, X_{2i}) \quad (4.3.3)$$

This model spells out one theoretical approach to the estimation of demand for air freight services. In practice little of the data concerning alternative modes, service qualities and commodity characteristics is readily available. Therefore, in order to successfully estimate the demand for air freight a simplified version of the model has been proposed. For clarity, at this point, a distinction will be made between demand for export air freight services and import air freight services.

Exports of goods by air freight will be expressed as follows:

$$E_i = {}^{\alpha}0 + {}^{\alpha}1\ Y_i + {}^{\alpha}2\ P_{0i} + {}^{\alpha}3\ P_{1i} + e_i \qquad (4.3.4)$$

with

$$i = 1, \ldots, 6$$

where i refers to the six world regions defined by the Commerce Department as major world areas of trade, and the other variables are as defined earlier.

Imports will be modelled as follows:

$$I_i = {}^{\beta}0 + {}^{\beta}1\ Y_{us} + {}^{\beta}2\ P_{0i} + {}^{\beta}3\ P_{1i} + U_i \qquad (4.3.5)$$

e_i, U_i are error terms of equations (4.3.4) and (4.3.5) respectively.

Several trials of this model form were attempted, but the relative price of goods indices did not prove statistically significant. Therefore, models (4.3.4) and (4.3.5) have been further simplified to the following forms.

$$E_i = {}^{\alpha}0 + {}^{\alpha}1\ Y_i + {}^{\alpha}2\ P_{1i} + e_i. \qquad (4.3.6)$$

$$I_i = {}^{\beta}0 + {}^{\beta}1\ Y_{us} + {}^{\beta}2\ P_{1i} + U_i.$$

4.4 The Data

In total, twenty-four models were estimated. Exports models were estimated for both total air shipments and U.S. flag carrier shipments across the six world regions. Similarly, imports models for these six areas for both total and U.S. flag carriers were estimated. This section describes the construction of the variables used in these models and the data sources.

For the export models, data was collected for total and U.S. flag shipments. The initial models (4.3.4), which were estimated, were of the following general form:

$$E_i = \alpha_0 + \alpha_1 P_{0i} + \alpha_2 Y_i + \alpha_3 P_{1i} + e_i.$$

Because the variable P_{0i} did not prove statistically significant it was dropped resulting in the estimated model of the following form:

$$E_i = \alpha_0 + \alpha_1 Y_i + \alpha_2 P_{1i} + e_i.$$

E_i, the dependent variable for total and flag exports represents the aggregate of export trade for each of the six world regions used in the U.S. Department of Commerce publications, FT986, United States Foreign Trade, U.S. Airborne Exports and General Imports, annual volumes 1964-1977.

P_{0i} represents the relative price of goods shipped to region i. Several relative price proxies were attempted and abandoned. These included a weighted index of exchange rates (which, if untampered with, indicated a weighted relative price of trade and money flows), and a relative consumer price index formulated from averages of selected nations' consumer price indices divided by the implicit U.S. GNP deflators.

Exchange rates are found in various volumes of International Financial Statistics, published by the International Monetary Fund (IMF). Consumer price indices are found in the United Nations, Statistical Yearbook, various volumes. The implicit GNP deflator is taken from the Economic Report to the President, 1978.

Y_i represents the aggregate Gross Domestic Product (GDP) of region i. Individual estimates of national GDP are available in various volumes of International Financial Statistics, published by the IMF. In order to convert these various currencies to one comparable currency, national GDP estimates were converted to U.S. currency by the appropriate exchange rates which were then aggregated by region. This process yielded current U.S. dollar estimates of GDP for the six regions. These estimates of GDP for the six regions were deflated to constant 1972 U.S. dollars using

the implicit U.S. GNP deflator. The GDP variable names for each of these regions are as follows:

North America	-	GDPNA.C
South America	-	GDPSA.C
Europe	-	GDPEU.C
Asia	-	GDPAS.C
Australia & Oceania	-	GDPAO.C
Africa	-	GDPAF.C

Definition of constituent countries for each of these regions is given in Appendix B.

P_{1i} represents the prices realized for air freight services to region i. Because the total of all air freight commodities are being dealt with as an aggregate and the geographical areas are large, rough price proxies were developed using average revenues per ton-mile. Current dollar estimates were derived from annual volumes of Air Carrier Traffic Statistics and Air Carrier Financial Statistics published by the U.S. Department of Transportation and the Civil Aeronautics Board. Constant dollar estimates were derived by deflating current dollar estimates with the implicit U.S. GNP deflator. Those estimates attempt to be as regionally specific as possible. They are aggregates of various U.S. carriers which serve these particular world areas.

In no case were more than four carriers per region included in the construction of these price proxies. These variations of the price proxy were constructed: simple average of all carriers included in the sample (up to a total of four); a weighted average price, with weights based upon the 1973 carrier revenue ton-miles; and price proxies based on a simple average of the all-cargo carriers for the region.

Following is a description of all the price variables which were calculated--some of which were not used in the final equations selected.

North America - RNA = simple average of American (Latin American Service), Continental, Eastern, and Western Airlines' revenues per ton-mile.

RNAW = weighted average of the above carriers' revenues per ton-mile based on 1973 revenue ton-mile based on 1973 revenue ton-miles reported in the DOT/CAB, Air Carrier Traffic Statistics.

South America - RSA = simple average of American (Latin American Service), Braniff, Pan American (Latin America Service), and Airlift Airlines' revenues per ton-mile.

RSAW = weighted average of above carriers' revenues per ton mile.

RSA.C - Airlift Airlines revenues per ton-mile.

Europe - REU = simple average of National, Pan American (Atlantic Service), Trans World and Seaboard World Airlines' revenues per ton-mile.

REUW = weighted average of the above carriers' revenues per ton-mile.

Asia - RAS - simple average of Northwest, Pan American (Pacific Service), and Flying Tiger Airlines' revenues per ton-mile.

RASW = weighted average of above carriers' revenues per ton-mile.

Australia & Oceania - RAO = Pan American (Pacific Service) revenues per ton-mile.

RAO.C - the lesser of either Pan American (Pacific Service) or Flying Tiger revenues per ton-mile.

Africa - RAF = Pan American (Atlantic Service) revenues per ton-mile.

The initial model for imports from the six world areas, (4.3.5) was as follows:

$$I_i = \beta_o + \beta_1 Y_{us} + \beta_2 P_{0i} + \beta_3 P_{1i} + U_i$$

For the same reason as in the export air freight models, P_{0i}, the price proxy for traded goods was dropped. That is, it provided unreliable estimates of price elasticities. Therefore, the import models were simplified to a form similar to the final export model. Therefore, the final model is as follows:

$$I_i = \beta_0 + \beta_1 Y_{us} + \beta_2 P_{1i} + U_i$$

Imports (I_i) of total and U.S. flag carrier air cargo volumes were also taken from the U.S. Department of Commerce, FT 986, providing aggregate flows of imports by all carriers and U.S. flag carriers from each of the six world regions.

All variables but Y_{us} have been defined earlier. Y_{us} is a constant dollar estimate of U.S. Gross National Product in 1972 dollars, taken from the Economic Report of the President, 1978.

In attempting to compile data to estimate the previously described models several difficulties were encountered. First, data concerning vessel rates and service quality is so limited that it

was impractical to collect for this study. Second, data on air service quality over these broad regions would be difficult to construct and also likely to be unreliable. Third, relative prices for goods in international trade are difficult to approximate. This is due in part to the fact that those relative price indices which are available tend to aggregate broad commodity groups. Goods shipped by air tend to be of higher quality and value than goods shipped by surface freight which makes available price indices inappropriate measures. This was verified when proxy price variables used in the model proved not to be statistically significant. Finally, consistent income and price deflators are not available across all regions. All these problems constrained the theoretical possibilities of the actual estimated models.

4.5 Empirical Results

In this section are detailed the results of the econometric estimation of the air freight demand models. Twenty-four models were estimated, including models for total and U.S. flag carriers exports and imports for the six world regions.

In all cases the period of observation was from 1964 to 1977. Regression equations and the appropriate statistics are reported in Tables 4.5.1 to 4.5.4.

Following the tables of estimated equations are the estimates of income and price elasticities. The elasticities are estimated at the historical mean values of the econometric equations. Using the generalized model:

$$E_i = \alpha_0 + \alpha_1 Y_i + \alpha_2 P_{1i} + e_i$$

Income and price elasticities are calculated as follows:

$$\text{Income elasticity} = \frac{\partial E_i^*}{\partial Y_i^*} \frac{Y_i^*}{\bar{E}_i^*} = \alpha_1 \frac{\bar{Y}^*}{\bar{E}_i^*}$$

$$\text{Price elasticity} = \frac{\partial E_i^*}{\partial P_{1i}^*} \frac{\bar{P}_{1i}^*}{\bar{E}_i^*} = \alpha_2 \frac{\bar{P}_{1i}^*}{\bar{E}_i^*}$$

where: E_i^* represents the dependent variables for individual regional exports, (I^* would be used to represent imports) as transformed from the original E_i.

TABLE 4.5.1
REGRESSION EQUATIONS (1) EXPORTS BY ALL AIR CARRIERS

(a) North America

$$(ENA)^{.6} = \underset{(2.49)}{1401.07} + \underset{(12.83)}{95.1754^{*}}\ (GDPNA.C)^{.6} \underset{(-3.46)}{-247.676^{*}}(RNA)^{.6}$$

$\bar{R}^2 = .9518$ F (2/11) = 129.347 DW = 1.41

(b) South America

$$(ESA)^{.4} = \underset{(0.14)}{11.8926} + \underset{(6.08)}{18.2908^{*}}\ (GDPSA.C)^{.4} \underset{(-0.46)}{- 8.94307^{*}}\ (RSA)^{.4}$$

$\bar{R}^2 = .8717$ F (2/11) = 45.147 DW = 1.34

(c) Europe

$$(EE) = \underset{(4.80)}{228.482} + \underset{(11.09)}{13.6275^{*}}\ (GDPEU.C)^{.4} \underset{(-7.74)}{- 79.1895^{*}}\ (REUW)^{.4}$$

$\bar{R}^2 = .968$ F (2/11) = 197.470 DW = 1.99

(d) Asia

$$(EA)^{.5} = \underset{(1.67)}{155.607} + \underset{(14.35)}{24.7132^{*}}\ (GDPAS.C)^{.5} \underset{(-5.58)}{- 66.0325}\ (RAS)^{.5}$$

$\bar{R}^2 = .9924$ F (2/11) = 848.688 DW = 1.25

(e) Australia & Oceania

$$(EAO)^{.4} = \underset{(-0.23)}{-8.48392} + \underset{(5.24)}{19.1535^{*}}\ (GDPAO.C)^{.4} \underset{(-1.53)}{- 9.94549^{*}}\ (RAO)^{.4}$$

(corrected for first order auto correlation, $\rho = .7459$)

$\bar{R}^2 = .801$ F (2/11) = 27.103 DW = 1.32

*t statistics in parentheses, t statistics of 1.35 are significant at the 90% confidence level.

TABLE 4.5.1 (continued)

(1) Exports by all air carriers (continued)

(f) Africa

$$(EAF)^{.6} = -132.448 + 60.0492^{*}\ (GDPAF.C)^{.6} - 36.4214^{*}\ (RAF)^{.6}$$
$$\qquad\qquad (-1.21)\quad (18.46)\qquad\qquad\qquad (-3.03)$$

(corrected for first order auto-correlation, $\rho = 0.1575$)

$\bar{R}^2 = .987$ F (2/11) = 289.055 DW = 2.05

*t statistics in parentheses, t statistics of 1.35 are significant at the 90% confidence level

TABLE 4.5.2

REGRESSION EQUATIONS (2) EXPORTS BY U.S. FLAG CARRIERS

(a) North America

$$(FENA)^{.6} = 1370.51 + 44.2121^{*}\ (GDPNA.C)^{.6} - 188.126^{*}\ (RNA)^{.6}$$
$$(2.42)\quad (5.17)\qquad\qquad (-2.74)$$

(corrected for first order auto-correlation, $\rho = .4923$)

$\bar{R}^2 = 79.36$ F (2/11) = 25.989 DW = 1.45

(b) South America

$$(FESA)^{.4} = 91.8907 + 10.4764^{*}\ (GDPSA.C)^{.4} - 27.519^{*}\ (RSA)^{.4}$$
$$(1.52)\quad (4.86)\qquad\qquad (-2.00)$$

$\bar{R}^2 = .8729$ F (2/11) = 45.656 DW = 1.17

(c) Europe

$$(FEEU)^{.4} = 171.592 + 7.61167^{*}\ (GDPEU.C)^{.4} - 53.1806^{*}\ (REUW)^{.4}$$
$$(4.19)\quad (7.20)\qquad\qquad (-6.04)$$

$\bar{R}^2 = .9366$ F (2/11) = 96.95 DW = 1.65

(d) Asia

$$(FEA)^{.5} = -19.4478 + 16.6691^{*}\ (GDPAS.C)^{.5} - 22.0822^{*}\ (RAS)^{.5}$$
$$(-0.30)\quad (12.26)\qquad\qquad (-2.76)$$

(corrected for second order auto-correlation, $\rho_1 = 1.4531$, $\rho_2 = 0.9684$)

$\bar{R}^2 = .9735$ F (2/11) = 239.803 DW = 2.47

(e) Australia and Oceania

$$(FEAO)^{.4} = 2.25848 + 13.0136^{*}\ (DPGAO.C)^{.4} - 10.0594^{*}\ (RAO)^{.4}$$
$$(0.10)\quad (8.77)\qquad\qquad (-2.04)$$

$\bar{R}^2 = .9357$ F (2/11) = ~~95.564~~ DW = 1.60

*t statistics in parentheses, t statistics of 1.35 are significant at the 90% confidence level.

TABLE 4.5.2 (continued)

(2) EXPORTS BY U.S. FLAG CARRIERS (continued)

(f) Africa

$$(FEAF)^{.7} = -404.841 + 41.2502^{*} (GDPAF.C)^{.7}$$
$$(-8.39) \quad (17.48)$$

(corrected for first order auto-correlation, $\rho = -0.1775$

$\bar{R}^2 = .9590$ F (2/11)= 305.383 DW = 1.99

*t statistics in parentheses, t statistics of 1.35 are significant at the 90% confidence level.

TABLE 4.5.3

REGRESSION EQUATIONS (3) IMPORTS BY ALL AIR CARRIERS

(a) North America

$$(INA)^{\cdot 4} = -292.897 + 24.5317^{*} (GNP)^{\cdot 4} - 4.65122^{*} (RNA)^{\cdot 4}$$
$$(-3.84) \quad (11.39) \quad (-0.34)$$

$\bar{R}^2 = .9410$ F (2/11) = 104.578 DW = 1.42

(b) South America

$$(ISA)^{\cdot 4} = -84.8295 + 23.7504^{*} (GNP)^{\cdot 4} - 71.984^{*} (RSA.C)^{\cdot 4}$$
$$(-0.5825) \quad (6.18) \quad (-2.39)$$

$\bar{R}^2 = .8955$ F (2/11) = 56.72 DW = 1.58

(c) Europe

$$(IE)^{\cdot 4} = -135.967 + 29.8751^{*} (GNP)^{\cdot 4} - 57.7431^{*} (REU)^{\cdot 4}$$
$$(-0.77) \quad (4.44) \quad (-2.47)$$

(corrected for second order auto-correlation, $\rho_1 = .9319$, $\rho_2 = -.3278$)

$\bar{R}^2 = .8532$ F (2/11) = 38.78 DW = 1.98

(d) Asia

$$(IA)^{\cdot 3} = -125.372 + 24.5867^{*} (GNP)^{\cdot 3} - 15.3455^{*} (RAS)^{\cdot 3}$$
$$(-1.01) \quad (2.39) \quad (-0.99)$$

$\bar{R}^2 = .9422$ F (2/11) = 107.019 DW = 1.37

(e) Australia and Oceania

$$(IAO)^{\cdot 3} = -.62.2714 + 9.98778^{*} (GNP)^{\cdot 3} - 3.16209^{*} (RAO.C)^{\cdot 3}$$
$$(-3.18) \quad (6.44) \quad (-1.09)$$

$\bar{R}^2 = .9603$ F (2/11) = 158.182 DW = 1.40

(f) Africa

$$\log (IAF) = -29.5794 + 5.56153^{*} \log (GNP) - 0.47699^{*} \log (RAF)$$
$$(-4.38) \quad (7.39) \quad (-0.85)$$

$\bar{R}^2 = .9275$ F (2/11) = 84.113 DW = 2.17

*t statistics in parentheses, t statistics of 1.35 are significant at the 90% confidence level.

TABLE 4.5.4

REGRESSION EQUATIONS (4) IMPORTS BY U.S. FLAG CARRIERS

(a) North America

$$(FINA)^{.4} = -99.1598 + 13.6126^{*} (GNP)^{.4} - 16.2218^{*} (RNA)^{.4}$$
$$(-1.94) \quad (9.44) \quad (-1.78)$$

$\bar{R}^2 = .9299$ F (2/11) = 87.184 DW = 1.62

(b) South America

$$(FISA)^{.4} = 50.9403 + 13.4284^{*} (GNP)^{.4} - 69.2533^{*} (RSA.C)^{.4}$$
$$(0.49) \quad (4.90) \quad (-3.22)$$

$\bar{R}^2 = .8818$ F (2/11) = 49.496 DW = 1.61

(c) Europe

$$(FIEU)^{.4} = -75.0773 + 21.9996^{*} (GNP)^{.4} - 51.3681^{*} (REU)^{.4}$$
$$(-0.81) \quad (6.69) \quad (-3.64)$$

(corrected for second order auto-correlation, $\rho_1 = .8919$, $\rho_2 = -.7822$)

$\bar{R}^2 = .9173$ F (2/11) = 73.136 DW = 1.78

(d) Asia

$$(FIA)^{.3} = -59.5696 + 15.9892^{*} (GNP)^{.3} - 15.7871^{*} (RAS)^{.3}$$
$$(-0.62) \quad (2.01) \quad (-1.31)$$

$\bar{R}^2 = .9403$ F (2/11 = 103.341 DW = 1.36

(e) Australia and Oceania

$$(FIAO)^{.3} = -54.8689 + 8.70864^{*} (GNP)^{.3} - 3.14531$$
$$(-2.51) \quad (5.03) \quad (-0.97)$$

$\bar{R}^2 = .9386$ F (2/11) = 100.349 DW = 1.93

(f) Africa

$$\log (FIAF) = -18.5743 + 3.91392^{*} \log (GNP) - .73008^{*} \log (RAF)$$
$$(-2.16) \quad (4.10) \quad (-1.01)$$

(corrected for first order auto-correlation, $\rho = -.3772$)

$\bar{R}^2 = .8219$ F (2/11) = 31.001 DW = 2.02

*t statistics in parentheses, t statistics of 1.35 are significant at the 90% confidence level.

Y_i^* represents the appropriate income variable (either GNP or GDP) as transformed from the original Y,

P_{1i}^* represents the appropriate price proxy variables as transformed from the original

and α_0, α_1, α_2, represent the estimated coefficients displayed in the regression results.

A bar above a variable represents notation for the historical mean values of the variable. These functional forms, except in the logged cases, allow flexible elasticity estimates which change with the values of the independent variables. Mean historical values of the variables were chosen to represent the average historical price and income elasticities. Table 4.5.5 presents the elasticity estimates for total and U.S. flag carrier export equations. Table 4.5.6 presents elasticity estimates for total and U.S. flag carrier import equations.

TABLE 4.5.5

EXPORT ELASTICITIES

Area	Type	All Carriers	U. S. Flag Carriers
North America	Income	1.99***	0.93***
	Price	-1.06***	-1.35***
South America	Income	1.118**	1.08***
	Price	-0.29	-1.44**
Europe	Income	1.22***	1.06***
	Price	-1.53***	-1.61***
Asia	Income	1.50***	1.60***
	Price	-0.94***	-0.50***
Australia/ Oceania	Income	1.88***	2.16***
	Price	-0.72*	-1.23**
Africa	Income	1.93***	1.96***
	Price	-0.61***	---

Significant at *** 99% level

** 95% level

* 90% level

TABLE 4.5.6

IMPORT ELASTICITIES

Area	Type	All Carriers	U.S. Flag Carriers
North America	Income	4.27***	3.38***
	Price	-0.18	-0.89**
South America	Income	4.99***	4.21***
	Price	-2.91**	-4.17***
Europe	Income	3.11***	3.27***
	Price	-1.25**	-1.59***
Asia	Income	5.66**	4.38**
	Price	-1.13	-1.39
Australia/ Oceania	Income	7.12***	8.43***
	Price	-0.69	-0.94
Africa	Income	5.56***	3.91***
	Price	-0.48	-0.73

Significant at *** 99% level

** 95% level

* 90% level

4.6 Cargo Forecasts

In order to forecast air cargo, all independent variables used in the air cargo models were forecast to the year 1991.

Forecasts of U.S. GNP used the Wharton Annual and Industry Forecasting Model, High Productivity Solution to the year 1990, completed December 1978, with results extrapolated to 1991 using the implied forecast growth rates from 1978 to 1990.

GDP forecasts for all regions are based on extrapolation of the 1964 to 1977 growth rates.

Three price scenarios were employed.

(1) First, extrapolation of the 1964 to 1977 growth rate. These forecasts all showed declining rates. In some cases it was necessary to impose a floor of 14 cent per ton-mile in 1972 dollars (roughly 20 cent in 1977 dollars) to limit the extrapolated price decline.

(2) The second forecast was for prices to remain constant at the 1977 level.

(3) The third forecast shows prices rising at 2 percent per annum throughout the forecast period.

TABLE 4.6.1

FORECASTED DISTRIBUTION OF U.S. EXPORTS BY ALL AIR CARRIERS BY CONTINENT (1978-1991)

(Percent of Total Forecasted Air Cargo by All Air Carriers)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	20.226	12.357	40.7	20.954	2.374	3.389	100.
1979	19.928	12.418	40.215	21.533	2.419	3.487	100.
1980	19.633	12.478	39.734	22.111	2.462	3.581	100.
1981	19.341	12.537	39.259	22.69	2.502	3.67	100.
1982	19.052	12.595	38.788	23.269	2.541	3.755	100.
1983	18.765	12.652	38.321	23.848	2.577	3.836	100.
1984	18.481	12.708	37.858	24.428	2.612	3.913	100.
1985	18.2	12.763	37.4	25.008	2.644	3.986	100.
1986	17.922	12.816	36.944	25.588	2.674	4.055	100.
1987	17.646	12.868	36.492	26.17	2.703	4.121	100.
1988	17.373	12.919	36.044	26.752	2.729	4.183	100.
1989	17.103	12.968	35.598	27.335	2.754	4.242	100.
1990	16.835	13.017	35.156	27.919	2.776	4.297	100.
1991	16.57	13.063	34.716	28.504	2.797	4.35	100.

TABLE 4.6.2

FORECASTED DISTRIBUTION OF U.S. IMPORTS BY ALL AIR CARRIERS BY CONTINENT (1978-1991)

(Percent of Total Forecasted Air Cargo by All Air Carriers)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	12.932	9.42	40.22	35.926	0.9	0.601	100.
1979	12.926	9.486	39.52	36.503	0.933	0.633	100.
1980	12.914	9.543	38.859	37.052	0.966	0.667	100.
1981	12.88	9.636	37.646	38.071	1.027	0.74	100.
1982	12.833	9.708	36.529	39.021	1.086	0.822	100.
1983	12.786	9.753	35.669	39.76	1.133	0.899	100.
1984	12.742	9.782	34.992	40.344	1.17	0.969	100.
1985	12.679	9.81	34.151	41.071	1.218	1.07	100.
1986	12.625	9.825	33.516	41.62	1.254	1.16	100.
1987	12.569	9.833	32.934	42.123	1.288	1.253	100.
1988	12.514	9.836	32.405	42.577	1.319	1.349	100.
1989	12.449	9.834	31.825	43.071	1.353	1.468	100.
1990	12.389	9.828	31.332	43.486	1.383	1.582	100.
1991	12.315	9.816	30.764	43.958	1.416	1.732	100.

Air cargo forecasts for each of the six world regions for both U.S. flag and all carriers are presented in the following tables. Forecasts are based on the models in the previous section and the variable forecasts above.

Tables 4.6.1 and 4.6.2 presents the forecasted regional shares for air cargo exports and imports. All of these forecasts rely upon the assumption that the social and economic structure remains somewhat stable--other than that economic impact reflected by the income and price variables. This is a necessary and reasonable assumption used in most models of this nature.

Tables 4.6.3 to 4.6.17 represent regional forecasts for total and U.S. flag carrier air cargo. Three scenarios are included with the middle scenario providing our base case and the other two providing high and low bands of expected forecasts. These estimates represent point estimates of future shipments.

Tables 4.6.18 and 4.6.19 display the percentage of imports to exports for the base case forecast for both total air cargo and for U.S. flag carriers. This number, though not entirely a directional load factor, can be used to get an indication of the dominant direction of air trade. Imports by all air carriers from Asia, for example, are expected to continue to significantly exceed exports, whereas in all other regions total air exports are larger than air imports. U.S. flag carriers will experience more import tonnage than export from both Europe and Asia, whereas in all other regions exports will exceed imports.

TABLE 4.6.3

BASE CASE FORECAST OF TOTAL AIR CARGO BY ALL AIR CARRIERS BY CONTINENT
(1978-1991)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	278.193	181.964	671.967	466.206	27.772	34.241	1660.34
1979	298.307	198.093	716.596	514.58	30.789	38.303	1796.67
1980	319.458	215.299	763.4	566.543	34.054	42.751	1941.5
1981	350.53	240.819	833.05	653.867	38.599	48.501	2165.36
1982	383.94	268.614	907.368	751.06	43.648	55.044	2409.67
1983	416.153	295.813	978.369	845.022	48.774	62.008	2646.14
1984	447.329	322.554	1046.67	935.795	53.973	69.36	2875.68
1985	485.39	355.423	1129.97	1054.05	60.299	78.369	3163.49
1986	521.34	387.027	1208.27	1165.02	66.573	87.709	3435.93
1987	558.585	420.229	1289.21	1281.93	73.254	97.953	3721.16
1988	596.865	454.869	1372.28	1403.78	80.315	109.094	4017.2
1989	639.914	494.138	1465.52	1546.26	88.327	122.115	4356.28
1990	682.779	533.955	1558.32	1689.01	96.573	135.936	4696.56
1991	732.037	579.94	1664.67	1860.3	106.091	152.544	5095.59

TABLE 4.6.4

LOW FORECAST OF TOTAL AIR CARGO BY ALL AIR CARRIERS BY CONTINENT
(1978-1991)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	275.139	178.662	657.763	460.646	27.516	34.005	1633.73
1979	292.006	191.188	687.124	502.755	30.243	37.802	1741.12
1980	309.711	204.481	717.556	547.715	33.18	41.949	1854.59
1981	337.075	225.184	768.833	626.164	37.335	47.331	2041.92
1982	366.532	247.502	823.103	712.972	41.939	53.432	2245.48
1983	394.559	268.86	872.752	795.568	46.571	59.892	2438.2
1984	421.316	289.478	918.475	874.136	51.229	66.682	2621.31
1985	454.645	315.131	976.768	977.659	56.929	74.979	2856.11
1986	485.619	339.37	1028.92	1073.26	62.529	83.538	3073.23
1987	517.607	364.72	1082.04	1173.44	68.471	92.885	3299.15
1988	550.342	391.07	1135.62	1277.27	74.726	103.01	3532.04
1989	587.499	421.062	1196.89	1399.2	81.838	114.785	3801.27
1990	624.174	451.335	1256.17	1520.4	89.117	127.228	4068.43
1991	666.845	486.458	1325.94	1666.75	97.547	142.085	4335.62

TABLE 4.6.5

HIGH FORECAST OF TOTAL AIR CARGO BY ALL AIR CARRIERS BY CONTINENT

(1978-1991)

(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	280.131	163.67	692.366	484.378	28.344	34.63	1703.52
1979	302.285	201.684	759.149	553.248	32.008	39.126	1887.5
1980	325.582	220.954	829.894	628.082	35.997	44.056	2084.56
1981	358.934	248.935	926.443	744.255	41.401	50.401	2370.37
1982	394.749	279.5	1030.15	853.77	47.431	57.654	2663.25
1983	429.479	309.677	1132.49	955.946	53.458	65.431	2946.48
1984	463.282	339.58	1233.97	1054.1	59.52	73.692	3224.14
1985	504.118	376.08	1353.78	1182.02	66.82	83.873	3566.69
1986	542.949	411.457	1470.25	1301.37	74.108	94.509	3894.64
1987	583.201	448.696	1591.65	1426.71	81.516	106.297	4238.03
1988	624.61	487.623	1717.43	1556.93	89.052	119.125	4594.77
1989	670.94	531.622	1856.62	1709.07	97.581	134.311	5000.14
1990	717.204	576.364	1983.83	1860.9	106.345	150.558	5395.2
1991	770.034	627.365	2120.16	2043.08	116.434	170.341	5847.41

TABLE 4.6.6

BASE CASE FORECAST OF U.S. EXPORTS BY ALL CARRIERS BY CONTINENT (1978-1991)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	176.01	107.529	354.174	182.341	20.662	29.495	870.211
1979	188.037	117.172	379.451	203.175	22.826	32.906	943.567
1980	200.823	127.636	406.431	226.172	25.181	36.628	1022.87
1981	214.415	138.988	435.223	251.544	27.741	40.686	1108.6
1982	228.86	151.304	465.946	279.524	30.522	45.108	1201.26
1983	244.213	164.661	498.721	310.369	33.541	49.921	1301.43
1984	260.525	179.145	533.684	344.356	36.817	55.158	1409.68
1985	277.858	194.848	570.976	381.794	40.367	60.851	1526.69
1986	296.272	211.871	610.747	423.019	44.213	67.038	1653.16
1987	315.835	230.321	653.156	468.398	48.377	73.756	1789.84
1988	336.612	250.315	698.372	518.336	52.882	81.049	1937.57
1989	358.682	271.978	746.574	573.272	57.754	88.961	2097.22
1990	382.12	295.448	797.956	633.694	63.02	97.541	2269.78
1991	407.009	320.871	852.723	700.129	68.709	106.842	2456.28

TABLE 4.6.7

LOW FORECAST OF U.S. EXPORTS BY ALL AIR CARRIERS BY CONTINENT (1978-1991)

(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	173.212	107.055	345.78	180.648	20.467	29.304	856.466
1979	182.276	116.17	362.003	199.59	22.411	32.505	914.955
1980	191.923	126.05	379.228	220.481	24.519	35.998	978.197
1981	202.192	136.757	397.518	243.516	26.804	39.805	1046.59
1982	213.122	148.361	416.944	268.909	29.279	43.954	1120.57
1983	224.758	160.934	437.577	296.899	31.96	48.472	1200.6
1984	237.144	174.557	459.502	327.741	34.861	53.388	1287.19
1985	250.328	189.316	482.796	361.721	38.	58.736	1380.9
1986	264.363	205.305	507.555	399.154	41.394	64.551	1482.32
1987	279.304	222.626	533.873	440.38	45.062	70.869	1592.11
1988	295.208	241.387	561.854	485.776	49.026	77.732	1710.98
1989	312.138	261.707	591.604	535.754	53.307	85.183	1839.69
1990	330.16	283.714	623.246	590.77	57.929	93.271	1979.09
1991	349.344	307.547	656.9	651.319	62.918	102.045	2130.07

TABLE 4.6.8

HIGH FORECAST OF U.S. EXPORTS BY ALL AIR CARRIERS BY CONTINENT (1978-1991)

(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	177.785	108.231	366.623	187.802	21.077	29.809	891.324
1979	191.676	118.643	405.503	214.593	23.704	33.556	987.673
1980	206.415	129.948	447.28	244.053	26.572	37.638	1091.9
1981	222.051	142.22	492.116	276.407	29.699	42.079	1204.57
1982	238.634	155.536	540.177	306.584	33.103	46.906	1320.94
1983	256.219	169.979	591.637	338.849	36.803	52.148	1445.64
1984	274.863	185.641	646.683	374.323	40.82	57.838	1580.17
1985	294.625	202.619	705.511	413.314	45.176	64.008	1725.25
1986	315.572	221.019	768.328	456.164	49.894	70.696	1881.67
1987	337.77	240.955	835.353	503.243	54.643	77.941	2049.9
1988	361.29	262.551	906.814	554.959	59.484	85.785	2230.88
1989	386.21	285.937	982.957	611.756	64.706	94.275	2425.84
1990	412.61	311.258	1050.5	674.123	70.337	103.458	2622.29
1991	440.576	338.196	1114.96	742.59	76.407	113.39	2826.12

TABLE 4.6.9

BASE CASE FORECAST OF U.S. IMPORTS BY ALL AIR CARRIERS BY CONTINENT (1978-1991)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	102.184	74.434	317.793	283.865	7.11	4.746	790.131
1979	110.269	80.922	337.145	311.405	7.963	5.397	853.1
1980	118.635	87.663	356.969	340.371	8.873	6.123	918.634
1981	136.115	101.831	397.827	402.323	10.857	7.815	1056.77
1982	155.079	117.31	441.422	471.536	13.125	9.936	1208.41
1983	171.94	131.153	479.648	534.653	15.233	12.087	1344.71
1984	186.804	143.409	512.989	591.439	17.157	14.203	1466.
1985	207.532	160.575	558.991	672.252	19.933	17.517	1636.8
1986	225.067	175.156	597.519	741.998	22.361	20.671	1782.77
1987	242.751	189.908	636.051	813.531	24.878	24.197	1931.31
1988	260.253	204.554	673.907	885.447	27.433	28.045	2079.64
1989	281.232	222.16	718.946	972.99	30.573	33.154	2259.06
1990	300.659	238.507	760.359	1055.31	33.553	38.394	2426.79
1991	325.028	259.069	811.947	1160.18	37.382	45.702	2639.3

TABLE 4.6.10

LOW FORECAST OF U.S. IMPORTS BY ALL AIR CARRIERS BY CONTINENT (1978-1991)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	101.927	71.607	311.983	279.997	7.049	4.701	777.264
1979	109.73	75.017	325.121	303.165	7.832	5.296	826.161
1980	117.788	78.431	338.328	327.234	8.661	5.952	876.393
1981	134.884	88.427	371.315	382.648	10.531	7.525	995.329
1982	153.409	99.141	406.158	444.063	12.659	9.478	1124.91
1983	169.801	107.926	435.175	498.669	14.611	11.421	1237.6
1984	184.172	114.922	458.973	546.395	16.367	13.294	1334.12
1985	204.317	125.815	493.972	615.937	18.929	16.242	1475.21
1986	221.256	134.065	521.363	674.103	21.136	18.987	1590.91
1987	238.303	142.095	548.162	733.056	23.409	22.016	1707.04
1988	255.134	149.682	573.767	791.492	25.7	25.278	1821.05
1989	275.36	159.354	605.287	863.445	28.531	29.601	1961.58
1990	294.014	167.621	632.925	929.632	31.188	33.958	2089.34
1991	317.501	178.911	669.04	1015.43	34.629	40.041	2255.55

TABLE 4.6.11

HIGH FORECAST OF U.S. IMPORTS BY ALL AIR CARRIERS BY CONTINENT (1978-1991)

(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	102.346	75.44	325.743	296.577	7.268	4.821	812.194
1979	110.609	83.042	353.646	338.656	8.304	5.57	899.825
1980	119.167	91.006	382.614	384.029	9.425	6.419	992.66
1981	136.883	106.715	434.327	467.848	11.702	8.322	1165.8
1982	156.115	123.964	489.97	547.185	14.328	10.748	1342.31
1983	173.26	139.699	540.852	617.096	16.655	13.282	1500.84
1984	188.419	153.939	587.282	679.782	18.7	15.854	1643.98
1985	209.493	173.461	648.272	768.703	21.645	19.865	1841.44
1986	227.378	190.438	701.918	845.207	24.214	23.813	2012.97
1987	245.431	207.741	756.298	923.469	26.873	28.316	2188.13
1988	263.321	225.073	810.616	1001.97	29.568	33.339	2363.89
1989	284.73	245.684	873.661	1097.31	32.875	40.037	2574.3
1990	304.594	265.106	933.328	1186.77	36.008	47.099	2772.91
1991	329.458	289.168	1005.21	1300.49	40.028	56.952	3021.3

TABLE 4.6.12

BASE CASE FORECAST OF U.S. EXPORTS BY U.S. FLAG CARRIER BY CONTINENT (1978-1991)
(000Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	68.3	35.627	108.848	71.808	6.646	7.262	298.492
1979	72.117	38.466	115.789	80.645	7.392	8.093	322.501
1980	76.156	41.529	123.166	90.436	8.207	8.997	348.49
1981	80.43	44.836	131.007	101.276	9.096	9.978	376.623
1982	84.954	48.405	139.34	113.271	10.066	11.043	407.079
1983	89.742	52.256	148.195	126.536	11.122	12.199	440.049
1984	94.809	56.413	157.607	141.195	12.271	13.452	475.747
1985	100.173	60.899	167.607	157.387	13.52	14.81	514.397
1986	105.85	65.741	178.236	175.263	14.878	16.282	556.249
1987	111.86	70.966	189.53	194.989	16.352	17.875	601.57
1988	118.222	76.605	201.53	216.746	17.951	19.6	650.653
1989	124.956	82.691	214.283	240.734	19.684	21.466	703.813
1990	132.086	89.258	227.832	267.17	21.562	23.484	761.392
1991	139.634	96.346	242.23	296.294	23.595	25.667	823.765

TABLE 4.6.13

LOW FORECAST OF U. S. EXPORTS BY U. S. FLAG AIR CARRIERS BY CONTINENT (1978-1991)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	66.847	34.879	106.072	71.453	6.546	7.262	293.058
1979	69.141	36.902	110.046	79.888	7.179	8.093	311.249
1980	71.584	39.077	114.256	89.229	7.866	8.997	331.009
1981	74.185	41.418	118.714	99.566	8.613	9.978	352.475
1982	76.956	43.937	123.437	111.001	9.424	11.043	375.798
1983	79.905	46.648	128.44	123.645	10.304	12.199	401.139
1984	83.044	49.566	133.742	137.616	11.257	13.452	428.678
1985	86.386	52.71	139.361	153.049	12.291	14.81	458.607
1986	89.943	56.096	145.318	170.09	13.411	16.282	491.14
1987	93.729	59.745	151.633	188.898	14.624	17.875	526.504
1988	97.759	63.678	158.329	209.65	15.937	19.6	564.952
1989	102.049	67.918	165.431	232.537	17.357	21.466	606.757
1990	106.614	72.49	172.965	257.771	18.894	23.484	652.216
1991	111.472	77.421	180.958	285.583	20.555	25.667	701.656

TABLE 4.6.14

HIGH FORECAST OF U.S. IMPORTS BY U. S. FLAG AIR CARRIERS BY CONTINENT (1978-1991)

(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	69.224	36.748	112.97	72.95	6.859	7.262	306.013
1979	74.003	40.819	124.385	83.035	7.846	8.093	338.181
1980	79.043	45.233	136.599	94.183	8.931	8.997	372.986
1981	84.359	50.014	149.656	106.493	10.122	9.978	410.622
1982	89.964	55.187	163.596	118.969	11.426	11.043	450.186
1983	95.875	60.781	178.464	132.554	12.85	12.199	492.723
1984	102.108	66.825	194.309	147.548	14.403	13.452	538.644
1985	108.681	73.35	211.178	164.09	16.092	14.81	588.202
1986	115.612	80.391	229.128	182.333	17.929	16.282	641.674
1987	122.921	87.983	248.211	202.442	19.726	17.875	699.158
1988	130.629	96.167	268.486	224.601	21.512	19.6	760.993
1989	138.757	104.983	290.016	249.008	23.44	21.466	827.669
1990	147.329	114.478	308.505	275.883	25.522	23.484	895.2
1991	156.37	123.899	325.738	305.466	27.768	25.667	964.906

TABLE 4.6.15

BASE CASE FORECAST OF U.S. IMPORTS BY U.S. FLAG AIR CARRIERS BY CONTINENT (1978-1991)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	36.218	24.601	137.015	136.021	3.194	0.865	337.914
1979	38.618	26.483	145.622	146.656	3.621	0.947	361.946
1980	41.083	28.428	154.448	157.712	4.08	1.035	386.785
1981	46.184	32.483	172.665	180.975	5.091	1.229	438.627
1982	51.654	36.872	192.138	206.455	6.263	1.455	494.837
1983	56.471	40.767	209.239	229.311	7.362	1.671	544.819
1984	60.686	44.195	224.172	249.611	8.374	1.871	588.909
1985	66.52	48.969	244.801	278.138	9.846	2.169	650.442
1986	71.422	53.002	262.095	302.464	11.142	2.437	702.562
1987	76.336	57.065	279.409	327.166	12.493	2.723	755.191
1988	81.176	61.082	296.434	351.777	13.872	3.021	807.361
1989	86.946	65.892	316.705	381.471	15.576	3.398	869.988
1990	92.264	70.343	335.359	409.158	17.2	3.768	928.091
1991	98.903	75.92	358.616	444.132	19.297	4.26	1001.13

TABLE 4.6.16

LOW FORECAST OF U. S. IMPORTS BY U. S. FLAG AIR CARRIERS BY CONTINENT (1978-1991)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	35.74	23.209	133.899	133.646	3.16	0.853	330.507
1979	37.623	23.61	139.175	141.665	3.546	0.92	346.539
1980	39.533	23.985	144.456	149.856	3.957	0.991	362.778
1981	43.966	26.128	158.443	169.466	4.901	1.16	404.063
1982	48.686	28.373	173.207	190.706	5.987	1.354	448.314
1983	52.71	30.024	185.356	209.003	6.992	1.532	485.616
1984	56.099	31.148	195.163	224.508	7.901	1.691	516.51
1985	60.973	33.214	209.865	247.224	9.239	1.932	562.447
1986	64.899	34.543	221.172	265.624	10.397	2.14	598.773
1987	68.782	35.764	232.179	283.963	11.596	2.356	634.64
1988	72.54	36.828	242.622	301.824	12.808	2.577	669.199
1989	77.112	38.348	255.622	323.831	14.315	2.857	712.085
1990	81.204	39.478	266.874	343.616	15.734	3.122	750.028
1991	86.46	41.271	281.801	369.396	17.583	3.479	799.989

TABLE 4.6.17

HIGH FORECAST OF U.S. IMPORTS BY U.S. FLAG AIR CARRIERS BY CONTINENT (1978-1991)
(000 Tons)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	36.523	25.1	141.292	143.869	3.284	0.886	350.954
1979	39.252	27.531	154.523	163.347	3.817	0.994	389.464
1980	42.07	30.074	168.318	184.257	4.4	1.113	430.231
1981	47.595	34.867	192.469	220.146	5.589	1.353	502.02
1982	53.539	40.097	218.556	250.845	6.98	1.641	571.657
1983	58.855	44.886	242.625	276.984	8.219	1.93	633.498
1984	63.587	49.252	264.783	300.116	9.31	2.215	689.262
1985	70.019	55.126	293.709	332.504	10.892	2.629	764.879
1986	75.525	60.279	319.393	360.025	12.281	3.026	830.529
1987	81.076	65.53	345.517	387.89	13.726	3.463	897.202
1988	86.578	70.796	371.711	415.582	15.198	3.936	963.8
1989	93.08	76.995	402.03	448.905	17.012	4.536	1042.56
1990	99.141	82.865	430.885	479.897	18.737	5.152	1116.68
1991	106.612	90.048	465.498	518.948	20.961	5.966	1208.03

TABLE 4.6.18

FORECAST RATIO OF U.S. IMPORTS TO TOTAL U.S. EXPORTS BY ALL AIR CARRIERS BY CONTINENT (1978-1991)

(percent)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	58.056	69.222	89.728	155.678	34.41	16.09	90.798
1979	58.642	69.062	88.851	153.269	34.886	16.402	90.412
1980	59.074	68.682	87.83	150.492	35.238	16.716	89.809
1981	63.482	73.266	91.408	159.941	39.138	19.208	95.325
1982	67.762	77.532	94.737	168.693	43.003	22.027	100.595
1983	70.406	79.65	96.176	172.264	45.415	24.211	103.326
1984	71.703	80.052	96.122	171.752	46.6	25.749	103.995
1985	74.69	82.41	97.901	176.077	49.379	28.787	107.212
1986	75.966	82.671	97.834	175.406	50.575	30.835	107.84
1987	76.86	82.454	97.381	173.683	51.425	32.807	107.904
1988	77.315	81.719	96.497	170.825	51.876	34.603	107.333
1989	78.407	81.683	96.299	169.726	52.937	37.268	107.716
1990	78.682	80.727	95.288	166.533	53.241	39.362	106.917
1991	79.858	80.739	95.218	165.709	54.406	42.775	107.451

TABLE 4.6.19

FORECAST RATIO OF U.S. IMPORTS TO TOTAL U.S. EXPORTS BY U.S. FLAG AIR CARRIERS BY CONTINENT
(1978-1991)

(percent)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	53.028	69.051	125.877	189.421	48.063	11.914	113.207
1979	53.548	68.849	125.765	181.853	48.985	11.704	112.231
1980	53.946	68.452	125.398	174.391	49.713	11.506	110.989
1981	57.421	72.448	131.799	178.694	55.973	12.318	116.463
1982	60.802	76.174	137.892	182.266	62.217	13.179	121.558
1983	62.926	78.013	141.192	181.222	66.198	13.695	123.809
1984	64.008	78.342	142.235	176.785	68.244	13.912	123.786
1985	66.405	80.41	146.056	176.722	72.82	14.646	126.447
1986	67.474	80.623	147.05	172.577	74.888	14.969	126.303
1987	68.243	80.412	147.422	167.787	76.403	15.232	125.537
1988	68.664	79.736	147.091	162.299	77.281	15.413	124.085
1989	69.581	79.685	147.797	158.462	79.13	15.832	123.611
1990	69.852	78.808	147.196	153.145	79.77	16.045	121.894
1991	70.83	78.799	148.048	149.896	81.782	16.596	121.531

Tables 4.6.20 and 4.6.21 show the forecasted regional share of U.S. flag air cargo to total air cargo.

It should be noted that more aggresive marketing in any particular region may change these forecast shares. Taking such an event into account is clearly outside out ability to foresee the future.

Finally Tables 4.6.22 to 4.6.26 give the projected growth rates of total and U.S. flag carrier air cargo volumes by region for our three scenarios.

TABLE 4.6.20

FORECAST SHARE OF U.S. FLAG AIR CARRIERS EXPORTS TO EXPORTS BY ALL AIR CARRIERS BY CONTINENT
(1978-1991)

(percent)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	38.805	33.132	30.733	39.381	32.164	24.622	34.301
1979	38.352	32.828	30.515	39.692	32.383	24.595	34.179
1980	37.922	32.537	30.304	39.985	32.591	24.562	34.07
1981	37.512	32.259	30.101	40.262	32.789	24.524	33.973
1982	37.12	31.992	29.905	40.523	32.978	24.482	33.888
1983	36.747	31.736	29.715	40.77	33.158	24.436	33.813
1984	36.392	31.49	29.532	41.003	33.33	24.388	33.748
1985	36.052	31.255	29.354	41.223	33.494	24.338	33.694
1986	35.727	31.029	29.183	41.431	33.651	24.287	33.648
1987	35.417	30.812	29.018	41.629	33.801	24.235	33.61
1988	35.121	30.604	28.857	41.816	33.945	24.182	33.581
1989	34.838	30.404	28.702	41.993	34.082	24.129	33.559
1990	34.567	30.211	28.552	42.161	34.214	24.076	33.545
1991	34.307	30.026	28.407	42.32	34.341	24.023	33.537

TABLE 4.6.21

FORECAST SHARE OF U.S. FLAG AIR CARRIERS IMPORTS TO IMPORTS BY ALL AIR CARRIERS BY CONTINENT

(1978-1991)

(percent)

	N. AMERICA	S. AMERICA	EUROPE	ASIA	AUSTRALIA	AFRICA	TOTAL
1978	35.444	33.051	43.114	47.917	44.925	18.232	42.767
1979	35.021	32.727	43.193	47.095	45.471	17.551	42.427
1980	34.629	32.428	43.266	46.335	45.979	16.907	42.104
1981	33.93	31.899	43.402	44.982	46.893	15.728	41.506
1982	33.308	31.431	43.527	43.784	47.713	14.648	40.95
1983	32.843	31.083	43.623	42.89	48.332	13.822	40.516
1984	32.486	30.817	43.699	42.204	48.81	13.177	40.171
1985	32.053	30.496	43.793	41.374	49.395	12.383	39.739
1986	31.733	30.26	43.864	40.763	49.828	11.79	39.408
1987	31.446	30.049	43.929	40.216	50.219	11.263	39.102
1988	31.191	29.861	43.987	39.729	50.569	10.771	38.822
1989	30.916	29.66	44.051	39.206	50.946	10.25	38.511
1990	30.687	29.493	44.105	38.771	51.262	9.814	38.244
1991	30.429	29.305	44.167	38.281	51.62	9.32	37.931

TABLE 4.6.22

FORECASTED GROWTH RATES OF TOTAL CARGO FLOWS BY ALL AIR CARRIERS (1977-1991)

(Average Annual Compounded Growth Rates)

(percent)

	North America	South America	Europe	Asia	Australia & Oceania	Africa	Total
			Base Case				
1977-1985	6.95	7.44	7.91	13.17	11.71	12.74	9.37
1985-1991	7.09	8.50	6.67	9.93	9.87	11.74	8.27
1977-1991	7.01	7.89	7.38	11.77	10.75	12.31	8.89
			Low Growth				
1977-1985	6.08	5.84	5.96	12.11	10.61	12.12	7.98
1985-1991	6.69	7.50	5.23	9.30	9.39	11.24	7.41
1977-1991	6.30	6.55	5.64	10.90	10.09	11.74	7.73
			High Growth				
1977-1985	7.45	8.20	10.37	14.80	12.85	13.70	11.02
1985-1991	7.32	8.90	7.76	9.55	9.70	12.53	8.59
1977-1991	7.40	8.50	9.25	12.52	11.49	13.20	9.97

TABLE 4.6.23

FORECASTED GROWTH RATES OF U.S. EXPORTS BY ALL AIR CARRIERS BY CONTINENT (1977-1991)

(Average Annual Compounded Growth Rates)

(percent)

	North America	South America	Europe	Asia	Australia & Oceania	Africa	Total
Base Case							
1977-1985	4.61	4.54	6.52	10.72	9.18	10.71	6.77
1985-1991	6.57	8.67	6.91	10.63	9.27	9.84	8.25
1977-1991	5.44	6.29	6.69	10.69	9.22	10.34	7.51
Low Growth							
1977-1985	3.25	4.16	4.31	9.98	8.36	10.22	5.63
1985-1991	5.71	8.42	5.27	10.30	8.77	9.64	7.49
1977-1991	4.30	5.97	4.72	10.12	8.53	9.97	6.42
High Growth							
1977-1985	5.37	5.05	9.38	11.83	10.73	11.22	5.63
1985-1991	6.94	8.91	7.93	10.26	9.15	10.00	8.57
1977-1991	6.04	6.69	8.75	11.15	10.05	10.08	8.60

TABLE 4.6.24

FORECASTED GROWTH RATES OF U.S. IMPORTS BY ALL AIR CARRIERS BY CONTINENT (1977-1991)

(Average Annual Compounded Growth Rates)

(percent)

	North America	South America	Europe	Asia	Australia & Oceania	Africa	Total
			Base Case				
1977-1985	11.04	12.29	9.51	14.81	17.69	24.37	12.13
1985-1991	7.76	8.30	6.42	9.52	11.05	17.33	8.29
1977-1991	9.26	10.56	8.17	12.51	14.80	21.30	10.47
			Low Growth				
1977-1985	10.82	8.91	7.82	12.56	16.94	23.20	10.69
1985-1991	7.62	6.04	5.19	8.69	10.59	16.23	7.33
1977-1991	9.44	7.67	6.69	11.45	14.17	20.16	9.24
			High Growth				
1977-1985	11.17	13.37	11.56	16.75	18.91	26.34	13.80
1985-1991	7.84	8.89	7.58	9.16	10.79	19.19	8.60
1977-1991	9.73	11.43	9.84	13.43	15.36	23.22	11.54

TABLE 4.6.25

FORECASTED GROWTH RATES OF U.S. EXPORTS BY U.S. FLAG AIR CARRIERS BY CONTINENT (1977-1991)

(percent)

	North America	South America	Europe	Asia	Australia & Oceania	Africa	Total
			Base Case				
1977-1985	4.06	3.11	7.13	13.15	7.67	10.12	7.43
1985-1991	5.59	7.95	6.33	11.12	9.73	9.60	8.16
1977-1991	4.76	5.15	6.79	12.28	8.55	8.89	7.74
			Low Growth				
1977-1985	2.15	1.26	4.59	12.76	6.40	10.12	5.90
1985-1991	4.34	6.62	4.45	10.96	8.95	9.60	7.34
1977-1991	3.09	3.52	4.59	11.98	7.48	9.89	6.51
			High Growth				
1977-1985	5.13	5.53	10.27	13.75	10.04	10.12	9.24
1985-1991	6.25	9.13	7.49	10.91	9.52	9.60	8.60
1977-1991	5.61	7.06	9.07	12.52	9.82	9.89	8.97

TALBE 4.6.26

FORECASTED GROWTH RATES OF U.S. IMPORTS BY U.S. FLAG AIR CARRIERS BY CONTINENT (1977-1991)

(percent)

	North America	South America	Europe	Asia	Australia & Oceania	Africa	Total
			Base Case				
1977-1985	8.36	15.22	12.15	11.78	18.93	16.32	11.85
1985-1991	6.83	7.58	6.57	8.11	11.87	11.91	7.45
1977-1991	7.70	11.88	9.72	10.19	15.85	14.41	9.94
			Low Growth				
1977-1985	7.18	9.76	10.01	10.15	17.99	14.65	9.82
1985-1991	5.99	3.69	5.03	6.92	11.32	10.30	6.05
1977-1991	6.67	7.11	7.85	8.75	15.08	12.77	8.19
			High Growth				
1977-1985	9.05	16.93	14.73	11.30	20.44	19.15	14.12
1985-1991	7.26	8.52	7.98	7.70	11.53	14.63	7.91
1977-1991	8.28	13.25	11.79	11.43	16.54	17.20	11.42

4.7 "Major Hub" Cargo Shares

Because of the scarcity of readily available data on actual international tons enplaned by all carriers for each "major hub," estimates of shares are necessarily crude. The basis for these estimates is 1977 Commerce Department data--FT986. Crude assumptions of air cargo distribution among the hubs were based upon a rough guess method which associates given customs districts with particular airport areas. Following are the tables of imports and exports distribution by "major hub" and hub share estimates for the forecast period. The assumption in these hub forecasts is that air cargo shipment distribution will remain the same as in 1977, i.e., no major new gateways. This assumption is the best working guess that can be made at this time.

Table 4.7.1 displays the selected hubs and the 1977 estimates of hub shares for both exports and imports. These estimates are assumed to remain stable over the forecast period. These estimates may not agree with CAB data for at least two reasons. First, CAB export tons remaining on the plane from earlier legs, and second, CAB reports only U.S. flag carrier shipments. Census data, on the other hand, takes into account all air cargo at the point it clears customs.

Tables 4.7.2, 4.6.3 and 4.7.4 show the forecasts for total imports, total exports, and total international cargo through the 24 "major hubs" Las Vegas has been excluded from this sample because

TABLE 4.7.1

AIR CARRIER CARGO VOLUMES FOR 24 MAJOR HUBS, 1977

	Export		Import	
Hub	(000 Tons)	Percent	(000 Tons)	Percent
Atlanta	.831	0.09	.226	0.03
Boston	26.094	2.91	16.662	2.54
Chicago	86.574	9.64	41.968	6.40
Cleveland	3.180	0.35	1.536	0.23
Dallas/Ft. Worth	2.716	0.30	.909	0.14
Devner	1.532	0.17	.252	0.04
Detroit	16.207	1.80	7.125	1.09
Honolulu	5.222	0.58	6.491	0.99
Houston	13.509	1.50	3.165	0.48
Kansas City	.386	0.04	.094	0.01
Los Angeles	60.566	6.74	66.819	10.20
Miami/Ft. Lauderdale	170.504	18.99	76.916	11.74
Minneapolis/St. Paul	2.752	0.31	1.131	0.17
New Orleans	5.138	0.57	2.618	0.40
New York	345.421	38.46	306.184	46.72
Philadelphia/Cambden	11.772	1.31	7.864	1.20
Pheonix	.178	0.02	.124	0.02
Pittsburg	.680	0.08	.244	0.04
St. Louis	.146	0.02	.396	0.06
San Francisco	30.596	3.41	46.601	7.11
San Juan	9.139	1.02	17.970	2.74
Seattle/Tacoma	14.526	1.62	16.940	1.67
Tampa/St. Petersburg	1.027	0.11	.212	0.03
Washington, D.C.	3.536	0.39	3.773	0.58
Total Hubs	812.234	90.44	620.220	94.64
Total All Cargo	898.069	100.00	655.352	100.00

TABLE 4.7.2

FORECASTED TOTAL AIR CARGO EXPORTS
FOR 24 MAJOR HUBS
(000 Tons)

	Low Growth	Base Case	High Growth
1978	774.5	786.93	806.023
1979	827.392	853.266	893.152
1980	884.583	924.979	987.407
1981	946.43	1002.5	1089.29
1982	1013.33	1086.3	1194.52
1983	1085.7	1176.88	1307.29
1984	1164.	1274.77	1428.94
1985	1248.74	1380.59	1560.14
1986	1340.46	1494.95	1701.59
1987	1439.75	1618.55	1853.73
1988	1547.24	1752.14	2017.38
1989	1663.63	1896.52	2193.69
1990	1789.69	2052.56	2371.33
1991	1926.22	2221.21	2555.65

TABLE 4.7.3
FORECASTED TOTAL AIR CARGO IMPORTS
FOR 24 MAJOR HUBS
(000 Tons)

	Low Growth	Base Case	High Growth
1978	733.891	746.04	766.872
1979	780.06	805.495	849.614
1980	827.488	867.372	937.268
1981	939.789	997.798	1100.74
1982	1062.14	1140.98	1267.41
1983	1168.54	1269.68	1417.09
1984	1259.68	1384.2	1552.24
1985	1392.89	1545.46	1738.68
1986	1502.13	1683.29	1900.64
1987	1611.79	1823.55	2066.03
1988	1719.44	1963.59	2231.98
1989	1852.12	2133.	2430.65
1990	1972.75	2291.37	2618.18
1991	2129.69	2492.03	2852.71

TABLE 4.7.4

FORECASTED TOTAL AIR CARGO (IMPORTS PLUS EXPORTS)
FOR 24 MAJOR HUBS

(000 Tons)

	LOW GROWTH	BASE CASE	HIGH GROWTH
1978	1508.39	1532.97	1572.89
1979	1607.45	1658.76	1742.77
1980	1712.07	1792.35	1924.68
1981	1886.22	2000.3	2190.03
1982	2075.46	2227.28	2461.93
1983	2254.24	2446.55	2724.38
1984	2423.68	2658.97	2981.18
1985	2641.64	2926.05	3298.83
1986	2842.59	3178.24	3602.24
1987	3051.53	3442.1	3919.75
1988	3266.68	3715.73	4249.36
1989	3515.75	4029.51	4624.33
1990	3762.44	4343.93	4989.51
1991	4055.91	4713.24	5408.36

foreign cargo is negligible. Newark has been included in NYC. San Juan has been added to the list because it has significant foreign air cargo traffic. The three forecast scenarios have been explained in the previous section.

Tables providing the forecasts for the individual hubs are included in Appendix A.

4.8 Conversion from Ton to Ton-Mile Forecasts

Because no reliable ton-mile estimates are available which parallel the world regions used in this report, no accurate historical measure is available to assess international ton-mile trends. In order to provide ton-mile forecasts for international cargo, an earlier air freight forecast (Maio and Wang, 1976) outlined an ad hoc method for deriving average length of haul for these six world regions. This method relied upon a determination of the statute miles between the major U.S. gateway serving the region and the capital cities for the nations constituting the particular region.

U.S. Gateway	World Region	Distance (Statute Miles)
MIA, DAL OR NYC	North America	600
MIA	South America	4000
NYC	Europe	4100
SFO or NYC	Asia	6300
SFO	Australia/Oceania	8900
NYC	Africa	6500

Using these mileage assumptions, estimates of historical and forecast revenue ton-miles have been produced on an aggregate basis. The historical estimates are presented first. The forecast estimates are presented in three scenarios (base case, and high and low price cases). Table 4.8.1 presents historical ton-mile estimates for total imports by U.S. flag, foreign flag and total air cargo. Table 4.8.2 provides the base case forecasts. Table 4.8.3 and 4.8.4 presents low and high revenue ton-mile forecasts.

Ton-mile estimates of total air cargo and U.S. flag air cargo shipments are calculated directly from our earlier tonnage forecasts and the preceeding distance estimates. Estimates of non-U.S. flag carrier shipments are the difference between our estimates of total air cargo ton-mileage and U.S. flag ton-mileage, i.e., a residual calculation. No estimates are provided for changing length of haul because no reasonable estimating basis is available.

Following are the tables of ton-mile estimates for the historical and forecast period.

TABLE 4.8.1

HISTORICAL ESTIMATED AIR CARGO TON-MILES
(Million of Ton-Miles)

(EXPORTS)

	U.S. FLAG	FOREIGN FLAG	TOTAL
1964	144.072	272.357	416.429
1965	248.333	443.948	692.281
1966	264.434	510.277	774.711
1967	308.32	626.168	934.488
1968	399.482	731.577	1131.09
1969	550.732	990.628	1541.36
1970	557.501	1051.28	1608.79
1971	582.564	1087.47	1670.02
1972	666.497	1324.87	1991.36
1973	910.095	1740.9	2651.
1974	1050.78	2036.09	3086.87
1975	905.483	1859.94	2765.42
1976	932.97	1972.15	2904.32
1977	1110.54	2382.55	3493.09

(IMPORTS)

	U.S. FLAG	FOREIGN FLAG	TOTAL
1964	108.284	116.711	224.995
1965	188.217	178.23	366.446
1966	226.019	222.095	448.115
1967	260.383	341.26	601.643
1968	404.979	448.083	853.062
1969	575.139	656.643	1231.78
1970	613.531	660.455	1273.99
1971	840.654	933.427	1774.08
1972	945.344	1073.2	2018.55
1973	973.473	1167.8	2141.27
1974	964.112	1257.43	2221.54
1975	1058.66	1301.97	2360.62
1976	1205.25	1558.93	2764.18
1977	1230.14	1657.33	2887.47

TABLE 4.8.2

FORECASTED BASE CASE AIR CARGO TON-MILES

(Million of Ton-Miles)

(EXPORTS)

	U.S. FLAG	FOREIGN FLAG	TOTAL
1978	1188.51	2323.69	3512.2
1979	1298.32	2535.98	3834.31
1980	1418.05	2766.42	4184.48
1981	1548.58	3016.52	4565.1
1982	1690.86	3287.9	4978.76
1983	1845.92	3582.33	5428.25
1984	2014.9	3901.73	5916.63
1985	2199.03	4248.18	6447.21
1986	2399.64	4623.92	7023.57
1987	2618.2	5031.39	7649.6
1988	2856.29	5473.25	8329.54
1989	3115.63	5952.3	9067.94
1990	3393.11	6471.73	9869.84
1991	3705.79	7034.86	10740.6

(IMPORTS)

	U.S.FLAG	FOREIGN FLAG	TOTAL
1978	1572.88	1971.6	3544.47
1979	1688.46	2151.48	3839.95
1980	1808.22	2340.3	4148.52
1981	2059.01	2743.13	4802.14
1982	2332.11	3192.08	5524.19
1983	2575.87	3600.91	6176.78
1984	2791.54	3968.5	6760.04
1985	3093.47	4491.66	7585.12
1986	3349.98	4943.47	8293.45
1987	3609.67	5407.34	9017.02
1988	3867.71	5874.43	9742.14
1989	4178.21	6444.28	10622.5
1990	4466.96	6981.58	11448.5
1991	4830.8	7668.34	12499.1

TABLE 4.8.3

FORECASTED LOW GROWTH SCENARIO AIR CARGO TON-MILES
(Million of Ton-Miles)

(EXPORTS)

	U.S. FLAG	FOREIGN FLAG	TOTAL
1978	1170.13	2290.43	3460.36
1979	1260.07	2466.34	3726.42
1980	1358.34	2657.08	4015.42
1981	1465.69	2863.91	4329.6
1982	1582.98	3088.22	4671.2
1983	1711.09	3331.53	5042.62
1984	1851.04	3595.48	5446.52
1985	2003.92	3881.83	5885.75
1986	2170.91	4192.55	6363.46
1987	2353.31	4529.74	6883.05
1988	2552.54	4895.71	7448.25
1989	2770.16	5292.9	8063.06
1990	3007.84	5724.1	8731.94
1991	3267.44	6192.2	9459.64

(IMPORTS)

	U.S.FLAG	FOREIGN FLAG	TOTAL
1978	1538.9	1945.09	3483.99
1979	1617.66	2095.31	3712.97
1980	1697.68	2251.21	3948.89
1981	1899.29	2611.05	4510.34
1982	2116.39	3009.33	5125.72
1983	2300.58	3363.1	5663.69
1984	2454.13	3672.21	6126.34
1985	2682.19	4123.39	6805.58
1986	2863.79	4501.18	7364.97
1987	3043.75	4884.77	7928.52
1988	3217.82	5265.86	8483.69
1989	3433.82	5736.51	9170.34
1990	3625.93	6170.92	9796.86
1991	3878.64	6736.24	10614.9

TABLE 4.8.4

FORECASTED HIGH GROWTH SCENARIO AIR CARGO TON-MILES
(Million of Ton-Miles)

(EXPORTS)

	U.S. FLAG	FOREIGN FLAG	TOTAL
1978	1247.23	2360.01	3607.24
1979	1392.81	2640.34	4033.15
1980	1551.35	2944.8	4496.16
1981	1723.86	3275.12	4998.98
1982	1904.43	3606.59	5511.03
1983	2099.45	3961.17	6060.62
1984	2311.24	4345.11	6656.35
1985	2541.17	4760.67	7301.84
1986	2790.7	5210.27	8000.97
1987	3059.66	5695.13	8754.79
1988	3349.92	6218.24	9568.16
1989	3664.65	6783.68	10448.3
1990	3987.97	7357.13	11345.1
1991	4325.89	7957.93	12283.8

(IMPORTS)

	U.S.FLAG	FOREIGN FLAG	TOTAL
1978	1642.97	2020.19	3663.16
1979	1836.74	2255.39	4092.12
1980	2042.85	2506.38	4549.23
1981	2402.61	2992.81	5395.42
1982	2741.71	3501.34	6243.05
1983	3040.31	3962.2	7002.51
1984	3308.75	4380.01	7688.77
1985	3675.53	4966.5	8642.04
1986	3993.07	5478.05	9471.13
1987	4315.77	6004.35	10320.1
1988	4638.15	6535.92	11174.1
1989	5021.14	7180.33	12201.5
1990	5381.17	7791.94	13173.1
1991	5827.4	8567.8	14395.2

5. SUMMARY AND CONCLUSIONS

In this study, econometric models for domestic and international air cargo activity were constructed and estimated. The new TSC air cargo models are composed of two major sub-models: domestic air cargo models estimated with the time series data from 1950 to 1978, and international air cargo model estimated with data from 1964 to 1977.

All forecasting models for air cargo activity have been estimated with alternative functional forms. The corrected functional form was chosen based on the Box-Cox transformation technique and our prior knowledge about the future possible behavior of air cargo traffic.

The models for domestic air cargo (freight plus express) activity are composed of three components: the passenger/cargo carrier model, scheduled and non-scheduled service; all-cargo carriers, scheduled service; and all-cargo carriers, non-scheduled service. The empirical results indicated that air cargo activity is a function of GNP in 1972 dollars and several price variables. The real price for motor carrier freight possesses a positive sign and is statistically significant in passenger/cargo carrier model estimated with data from 1964 to 1977.

In comparison with previous TSC models, the major improvement of this revised model is the construction of price proxy variables for each of the six world regions. Regression results indicate that most co-efficients of the revised price proxy variable have the expected signs and are statistically significant.

Alternative annual forecasts from 1979 to 1991 have been generated from the new TSC air cargo models with alternative scenarios of future values of GNP in 1972 dollars and real yield per revenue ton-mile. Tables 5.1 and 5.2 summarize the base forecasts for domestic air cargo activity in terms of revenue ton-miles and tonnages. Tables 5.3 and 5.4 present the base forecasts for international air cargo activity in terms of revenue ton-miles and tonnages. Total U.S. air cargo traffic (domestic and international) is shown in Tables 5.5 and 5.6.

In summary, domestic air cargo activity (RTM) will continue to grow with growth rates in the range of 5 to 8 percent. International air cargo activity is expected to hike with growth rates from 6 to 8 percent. On a regional basis, Asia and Europe will account for 63.3 percent of total air cargo activity (RTM) in the forecasting period. The US-Asia air cargo traffic activty is expected to enjoy faster growth rates than those of US-Europe air cargo activity. Further, at the end of 1990, US-Asia air cargo activity will be roughly equal to the same volumes of US-Europe air cargo activity. Finally, it should be mentioned

TABLE 5.1

U.S. DOMESTIC AIR CARGO TRAFFIC
(freight plus express)

2.9% Growth Rate

		Domestic Air Cargo Tons Enplaned (thousands)			Domestic Air Cargo Ton Miles (millions)		
	Year	Passenger/ Cargo	All-Cargo	Total	Passenger/ Cargo	All-Cargo	Total
Historical	1971	2026	170	2195	2139	300	2439
	1972	1941	218	2159	2347	369	2715
	1973	2410	307	2717	2470	505	2975
	1974	2286	321	2608	2432	508	2940
	1975	1623	214	1837	2339	446	2785
	1976	2398	286	2673	2493	452	2945
	1977	2348	330	2669	2687	507	3194
	1978	2396	501	2897	2721	841	3563
Forecasted	1979	2491	664	3154	2827	1115	3942
	1980	2561	776	3337	2907	1304	4211
	1981	2721	881	3602	3088	1480	4568
	1982	2898	989	3887	3289	1661	4951
	1983	3051	1093	4145	3463	1837	5300
	1984	3191	1194	4385	3622	2005	5627
	1985	3392	1315	4707	3850	2209	6059
	1986	3590	1450	5040	4074	2436	6511
	1987	3773	1590	5362	4282	2670	6952
	1988	3933	1726	5658	4464	2899	7362
	1989	4136	1881	6016	4694	3159	7853
	1990	4330	2045	6375	4914	3436	8350
	1991	4526	2220	6745	5137	3729	8866

NOTES ON TABLE 5.1

- Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Control Solution (average annual growth rate 2.9%)

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level

  Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level

- Passenger cargo tons enplaned forecast assumes a domestic passenger/cargo average haul of 1135 miles

  All cargo tons enplaned forecast assumes a domestic all-cargo average haul of 1680

TABLE 5.2

U.S. DOMESTIC AIR CARGO TRAFFIC
(freight plus express)

3.2% Growth Rate

		Domestic Air Cargo Tons Enplaned (thousands)			Domestic Air Cargo Ton Miles (millions)		
	Year	Passenger/ Cargo	All-Cargo	Total	Passenger/ Cargo	All-Cargo	Total
Historical	1971	2026	170	2195	2139	300	2439
	1972	1941	218	2159	2347	369	2715
	1973	2410	307	2717	2470	505	2975
	1974	2286	321	2608	2432	508	2940
	1975	1623	214	1837	2339	446	2785
	1976	2398	286	2673	2493	452	2945
	1977	2348	330	2669	2687	507	3194
	1978	2396	501	2897	2721	841	3563
Forecasted	1979	2491	664	3154	2827	1115	3942
	1980	2596	785	3381	2946	1319	4266
	1981	2810	912	3722	3190	1532	4721
	1982	3035	1047	4083	3445	1760	5205
	1983	3230	1183	4412	3666	1987	5653
	1984	3398	1311	4709	3856	2203	6059
	1985	3627	1461	5088	4116	2455	6571
	1986	3816	1613	5429	4331	2709	7041
	1987	4004	1767	5771	4544	2968	7513
	1988	4187	1924	6111	4752	3232	7985
	1989	4403	2101	6504	4998	3529	8527
	1990	4600	2283	6884	5221	3836	9058
	1991	4844	2496	7340	5498	4193	9691

NOTES ON TABLE 5.2

- Forecasts utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity Solution (average annual growth rate 3.2%)

- Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level

  Domestic all-cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level

- Passenger/cargo tons enplaned forecast assumes a domestic passenger/cargo average haul of 1135 miles

  All-cargo tons enplaned forecast assumes a domestic all-cargo average haul of 1680 miles

TABLE 5.3

U.S. INTERNATIONAL AIR CARGO TRAFFIC

ALL SERVICES FROM ALL U.S. AIRPORTS (EXPORTS)

Calendar Year	Revenue -- Cargo Enplaned Tons (thousands)			Revenue -- Cargo Ton Miles (millions)		
	U.S. Flag Carriers	Foreign Flag Carrier	Total	U.S. Flag Carriers	Foreign Flag Carrier	Total
1978	299	571	870	1188.51	2323.69	3512.2
1979	323	621	944	1298.32	2535.98	3834.31
1980	349	673	1022	1418.05	2766.42	4184.48
1981	477	731	1108	1548.58	3016.52	4565.1
1982	407	794	1201	1690.86	3287.9	4978.76
1983	440	861	1301	1845.92	3582.33	5428.25
1984	475	933	1409	2014.9	3901.73	5916.63
1985	514	1013	1527	2199.03	4248.18	6447.21
1986	556	1097	1653	2399.64	4623.92	7023.57
1987	602	1187	1789	2618.2	5031.39	7649.6
1988	650	1287	1937	2856.29	5473.25	8329.54
1989	704	1393	2097	3115.63	5952.3	9067.94
1990	761	1508	2269	3398.11	6471.73	9869.84
1991	824	1632	2456	3705.79	7034.86	10740.6

TABLE 5.4

U.S. INTERNATIONAL AIR CARGO TRAFFIC

ALL SERVICES FROM ALL U. S. AIRPORTS (IMPORTS)

Calendar Year	Revenue -- Cargo Enplaned Tons (thousands)			Revenue -- Cargo Ton Miles (million)		
	U.S. Flag Carriers	Foreign Flag Carrier	Total	U.S. Flag Carriers	Foreign Flag Carriers	Total
1978	338	452	790	1572.88	1971.6	3544.47
1979	362	491	853	1688.46	2151.48	3839.95
1980	387	532	919	1808.22	2340.3	4148.52
1981	439	618	1057	2059.01	2742.13	4802.14
1982	495	713	1208	2332.11	3192.08	5524.19
1983	545	789	1334	2575.87	3600.91	6176.78
1984	589	857	1466	2791.54	3968.5	6760.04
1985	650	986	1636	3093.47	4491.66	7585.12
1986	703	1079	1782	3349.98	4943.47	8293.45
1987	755	1176	1931	3609.67	5407.34	9017.02
1988	807	1272	2079	3867.71	5874.43	9742.14
1989	870	1389	2259	4178.21	6444.28	10622.5
1990	928	1499	2427	4466.96	6981.58	11448.5
1991	1001	1638	2639	4830.8	7668.34	12499.1

TABLE 5.5

U.S. AIR CARGO TRAFFIC[1]
ALL SERVICES AT U.S. AIRPORTS[2]

Calendar Year	Revenue Cargo Enplaned Tons[3] (thousands)			Revenue Cargo Ton-Miles[4] (millions)		
	Total	U.S.[1] Domestic	International	Total	U.S. Domestic	International
Historical*						
1974	3,399	2,608	791	8,248	2,940	5,308
1975	2,540	1,837	703	7,911	2,785	5,126
1976	3,414	2,673	741	8,613	2,945	5,668
1977	3,560	2,669	891	9,575	3,194	6,381
1978	3,799	2,897	902	10,620	3,563	7,057
Forecast						
1979	4,098	3,154	944	11,616	3,942	7,674
1980	4,403	3,381	1,022	12,599	4,266	8,333
1981	4,830	3,722	1,108	13,638	4,721	9,367
1982	5,284	4,083	1,201	15,708	5,205	10,503
1983	5,713	4,412	1,301	17,258	5,653	11,605
1984	6,118	4,709	1,409	18,736	6,059	12,677
1985	6,615	5,088	1,527	20,603	6,571	14,032
1986	7,082	5,429	1,653	22,358	7,041	15,317
1987	7,560	5,771	1,789	24,197	7,513	16,666
1988	8,048	6,111	1,937	26,061	7,895	18,076
1989	8,601	5,504	2,097	28,217	8,527	19,690
1990	9,153	6,884	2,269	30,375	9,057	21,318
1991	9,795	7,339	2,456	32,930	9,691	23,239

r Revised * Source: CAB Air Carrier Traffic Statistics and U.S. Department of Commerce, Bureau of the Census

(1) Includes Freight and Express
(2) Includes scheduled and nonscheduled service of all U.S. and Foreign Flag Carriers
(3) Exports only
(4) Includes Imports plus Exports

TABLE 5.6

U.S. AIR CARGO TRAFFIC[1] (INCLUDING MAIL)

ALL SERVICES AT U.S. AIRPORTS[2]

	Calendar Year	Revenue Cargo Enplaned Tons[3] (thousands) Total	U.S. Domestic[1]	International	Revenue Cargo Ton-Miles[4] (millions) Total	U.S. Domestic	International
Forecast	1979	5201	4126	1075	13101	4809	8201
	1980	5523	4367	1156	14018	5146	8872
	1981	5957	4715	1242	15514	5607	9907
	1982	6393	5057	1336	17127	6074	11053
	1983	6819	5379	1440	18686	6515	12171
	1984	7237	5687	1550	20186	6931	13255
	1985	7757	6086	1671	22083	7461	14622
	1986	8248	6448	1800	23870	7950	15920
	1987	8753	6814	1939	25726	8443	17283
	1988	9269	7179	2090	27646	8938	18708
	1989	9850	7597	2253	29839	9502	20337
	1990	10435	8006	2429	32042	10058	21984
	1991	11102	8483	2619	34630	10712	23918

(1) Includes Freight, Express and Mail[5]

(2) Includes scheduled and nonscheduled service of all U.S. and Foreign Flag Carriers Exports only

(3) Exports only

(4) Includes Imports plus Exports

(5) Mail forecasts are derived from "Forecasting Models for Domestic and International Air Mail" by Washington Data Processing, Inc. for FAA/AVP-120

Source: CAB Air Carrier Traffic Statistics and U.S. Department of Commerce, Bureau of the Census

that the forecasts presented in this study implicitly assume that basic structural relationships among the variables within the sample period will remain the same through 1991.

The new TSC models will be updated as new observations become available and the quality of the forecasts from these models will be evaluated. The building of a working forecasting system is an iterative process. It requires time to test the predictive ability of the models. Subsequent modifications will be made on the specification of the models to incorporate new information (or new events) into the model, this information being unavailable at the time of the forecasts.

6. REFERENCES

(1) Air Transport Association of America, Domestic and International Connected Cargo Forecast 1975-2000

(2) Box, G. E. P. and C. R. Cox, "An Analysis of Transformation" Journal of Royal Statistical Society, (1964) Series B, 26, pp. 211-243

(3) Box, G.E.P., "Science and Statistics," Journal of American Statistical Association (1976) 71, pp. 791-799

(4) Civil Aeronautics Board, Air Carrier Traffic Statistics, various issues

(5) ----------, Air Carrier Financial Statistics, various issues

(6) ----------, Handbook of Airline Statistics, 1974 Edition

(7) ----------, Supplement to Handbook of Airline Statistics, 1975 and 1976

(8) ----------, Airport Activity Statistics, December 31, 1977

(9) Cohen, D.R., "Planning for Air Cargo Development", Airport Economic Planning, edited by G. Howard, MIT Press (1974)

(10) Gaudry, M. J. and M. J. Wills, "Estimating the Functional Form of Travel Demand Models," Transportation Research (1978), pp. 257-289

(11) International Monetary Fund, International Financial Statistics, various issues from 1965 to 1975

(12) Interstate Commerce Commission, Bureau of Economics, Transport Economics, various issues

(13) Maio, D., G.H.K. Wang and N. Meltzer, Forecasting Models for Air Freight Demand and Projection of Cargo Activity at U.S. Air Hubs, FAA, Office of Aviation Policy, FAA-AVP-77-2, January 1977

(14) U.S. Department of Commerce, Guide to Foreign Trade Statistics, various issues from 1965 to 1977

(15) ----------, U.S. Foreign Trade: Airborne Exports and General Imports, various issues

(16) ----------, Survey of Current Business, various issues

(17) United Nations, Statistical Yearbook, various issues from 1965 to 1977

(18) Woolsey, J. P., "Tiger is off to a fast start in Deregulated Cargo Arena," Air Transport World, February, 1979, pp. 34-43

(19) Wharton Econometric Associates, Wharton Annual and Industry Forecasting Model, Post-Meeting Control Solution to the Year 2000.

(20) White, Kenneth J., "Estimation of the Liquidity Trap with a Generalized Functional Form," (1972) Econometrica 40, pp. pp. 193-199

(21) Zarembka, Paul, "Functional Form in Demand for Money," Journal of the American Statistical Association, 63, (1968) pp. 502-511

(22) ----------, Toward a Theory of Economic Development (1972) Holden-Day, San Francisco

APPENDIX A - HUB SPLIT FORECASTS

This appendix presents hub split forecasts for the individual "Major Hubs" serving international markets. Twenty-four hubs were included in this breakdown. These hubs are displayed in Table 4.7.1 in the body of the report.

The three forecasts for each hub's exports and imports are based on our three price forecasts also explained in the test of this report. These forecasts presented in Table A.2.1. to A.2.2 are in thousands of tons of air cargo.

FORECASTED EXPORTS OF AIR CARGO FOR SELECTED HUBS
(000 tons)

Atlanta

	Low	Most Likely	High
1978	0.771	0.783	0.802
1979	0.823	0.849	0.889
1980	0.88	0.921	0.983
1981	0.942	0.998	1.084
1982	1.009	1.081	1.189
1983	1.081	1.171	1.301
1984	1.158	1.269	1.422
1985	1.243	1.374	1.553
1986	1.334	1.488	1.694
1987	1.433	1.611	1.845
1988	1.54	1.744	2.008
1989	1.656	1.887	2.183
1990	1.781	2.043	2.36
1991	1.917	2.211	2.544

Boston

	Low	Most Likely	High
1978	24.923	25.323	25.938
1979	26.625	27.458	28.741
1980	28.466	29.766	31.774
1981	30.456	32.26	35.053
1982	32.609	34.957	38.439
1983	34.937	37.871	42.068
1984	37.457	41.022	45.983
1985	40.184	44.427	50.205
1986	43.136	48.107	54.757
1987	46.33	52.084	59.652
1988	49.79	56.383	64.919
1989	53.535	61.029	70.592
1990	57.591	66.051	76.309
1991	61.985	71.478	82.24

Chicago

	Low	Most Likely	High
1978	82.563	83.888	85.924
1979	88.202	90.96	95.212
1980	94.298	98.605	105.26
1981	100.891	106.869	116.121
1982	108.023	115.802	127.338
1983	115.738	125.458	139.359
1984	124.085	135.894	152.328
1985	133.118	147.173	166.314
1986	142.896	159.365	181.393
1987	153.48	172.541	197.611
1988	164.939	186.781	215.057
1989	177.347	202.172	233.851
1990	190.784	218.807	252.789
1991	205.339	236.786	272.437

Cleveland

	Low	Most Likely	High
1978	2.998	3.046	3.12
1979	3.202	3.302	3.457
1980	3.424	3.58	3.822
1981	3.663	3.88	4.216
1982	3.922	4.204	4.623
1983	4.202	4.555	5.06
1984	4.505	4.934	5.531
1985	4.833	5.343	6.038
1986	5.188	5.786	6.586
1987	5.572	6.264	7.175
1988	5.988	6.781	7.808
1989	6.439	7.34	8.49
1990	6.927	7.944	9.178
1991	7.455	8.597	9.891

Dallas/Ft. Worth

	Low	Most Likely	High
1978	2.569	2.611	2.674
1979	2.745	2.831	2.963
1980	2.935	3.069	3.276
1981	3.14	3.326	3.614
1982	3.362	3.604	3.963
1983	3.602	3.904	4.337
1984	3.862	4.229	4.74
1985	4.143	4.58	5.176
1986	4.447	4.959	5.645
1987	4.776	5.37	6.15
1988	5.133	5.813	6.693
1989	5.519	6.292	7.278
1990	5.937	6.809	7.867
1991	6.39	7.369	8.478

Denver

	Low	Most Likely	High
1978	1.456	1.479	1.515
1979	1.555	1.604	1.679
1980	1.663	1.739	1.856
1981	1.779	1.885	2.048
1982	1.905	2.042	2.246
1983	2.041	2.212	2.458
1984	2.188	2.396	2.686
1985	2.348	2.595	2.933
1986	2.52	2.81	3.199
1987	2.707	3.043	3.485
1988	2.909	3.294	3.792
1989	3.127	3.565	4.124
1990	3.364	3.859	4.458
1991	3.621	4.176	4.804

Detroit

	Low	Most Likely	High
1978	15.416	15.664	16.044
1979	16.469	16.984	17.778
1980	17.608	18.412	19.654
1981	18.839	19.955	21.682
1982	20.17	21.623	23.777
1983	21.611	23.426	26.021
1984	23.169	25.374	28.443
1985	24.856	27.48	31.055
1986	26.682	29.757	33.87
1987	28.658	32.217	36.898
1988	30.798	34.876	40.156
1989	33.114	37.75	43.665
1990	35.624	40.856	47.201
1991	38.341	44.213	50.87

Honolulu

	Low	Most Likely	High
1978	4.968	5.047	5.17
1979	5.307	5.473	5.729
1980	5.674	5.933	6.333
1981	6.07	6.43	6.987
1982	6.499	6.967	7.661
1983	6.963	7.548	8.385
1984	7.466	8.176	9.165
1985	8.009	8.855	10.006
1986	8.597	9.588	10.914
1987	9.234	10.381	11.889
1988	9.924	11.238	12.939
1989	10.67	12.164	14.07
1990	11.479	13.165	15.209
1991	12.354	14.246	16.391

Houston

	Low	Most Likely	High
1978	12.847	13.053	13.37
1979	13.724	14.154	14.815
1980	14.673	15.343	16.379
1981	15.699	16.629	18.069
1982	16.809	18.019	19.814
1983	18.009	19.521	21.685
1984	19.308	21.145	23.702
1985	20.713	22.9	25.879
1986	22.235	24.797	28.225
1987	23.882	26.848	30.749
1988	25.665	29.063	33.463
1989	27.595	31.458	36.388
1990	29.686	34.047	39.334
1991	31.951	36.844	42.392

Kansas City

	Low	Most Likely	High
1978	0.343	0.348	0.357
1979	0.366	0.377	0.395
1980	0.391	0.409	0.437
1981	0.419	0.443	0.482
1982	0.448	0.481	0.528
1983	0.48	0.521	0.578
1984	0.515	0.564	0.632
1985	0.552	0.611	0.69
1986	0.593	0.661	0.753
1987	0.637	0.716	0.82
1988	0.684	0.775	0.892
1989	0.736	0.839	0.97
1990	0.792	0.908	1.049
1991	0.852	0.983	1.13

Los Angeles

	Low	Most Likely	High
1978	57.726	58.652	60.075
1979	61.668	63.596	66.569
1980	65.93	68.941	73.594
1981	70.54	74.719	81.188
1982	75.526	80.965	89.031
1983	80.92	87.716	97.436
1984	86.757	95.013	106.503
1985	93.072	102.899	116.282
1986	99.908	111.423	126.825
1987	107.308	120.635	138.163
1988	115.32	130.592	150.361
1989	123.995	141.353	163.502
1990	133.391	152.983	176.742
1991	143.567	165.553	190.48

Miami/Ft. Lauderdale

	Low	Most Likely	High
1978	162.643	165.253	169.262
1979	173.75	179.183	187.559
1980	185.76	194.243	207.353
1981	198.748	210.523	228.748
1982	212.796	228.12	250.846
1983	227.994	247.141	274.526
1984	244.438	267.699	300.073
1985	262.232	289.919	327.625
1986	281.493	313.935	357.33
1987	302.342	339.891	389.277
1988	324.916	367.944	423.645
1989	349.358	398.262	460.667
1990	375.829	431.031	497.972
1991	404.5	466.448	536.679

Minneapolis/St. Paul

	Low	Most Likely	High
1978	2.655	2.698	2.763
1979	2.836	2.925	3.062
1980	3.032	3.171	3.385
1981	3.244	3.437	3.734
1982	3.474	3.724	4.095
1983	3.722	4.034	4.481
1984	3.99	4.37	4.899
1985	4.281	4.733	5.348
1986	4.595	5.125	5.833
1987	4.936	5.549	6.355
1988	5.304	6.006	6.916
1989	5.703	6.501	7.52
1990	6.135	7.036	8.129
1991	6.603	7.614	8.761

New Orleans

	Low	Most Likely	High
1978	4.882	4.96	5.081
1979	5.215	5.378	5.63
1980	5.576	5.83	6.224
1981	5.966	6.319	6.866
1982	6.387	6.847	7.529
1983	6.843	7.418	8.24
1984	7.337	8.035	9.007
1985	7.871	8.702	9.834
1986	8.449	9.423	10.726
1987	9.075	10.202	11.684
1988	9.753	11.044	12.716
1989	10.486	11.954	13.827
1990	11.281	12.938	14.947
1991	12.141	14.001	16.109

New York

	Low	Most Likely	High
1978	329.397	334.683	342.803
1979	351.892	362.896	379.859
1980	376.215	393.396	419.947
1981	402.519	426.366	463.278
1982	430.971	462.006	508.033
1983	461.75	500.529	555.991
1984	495.053	542.164	607.732
1985	531.092	587.166	663.532
1986	570.1	635.805	723.691
1987	612.326	688.373	788.393
1988	658.044	745.187	857.997
1989	707.546	806.591	932.978
1990	761.157	872.957	1008.53
1991	819.225	944.686	1086.92

Philadelphia/Camden

	Low	Most Likely	High
1978	11.22	11.4	11.676
1979	11.986	12.361	12.939
1980	12.814	13.4	14.304
1981	13.71	14.523	15.78
1982	14.679	15.737	17.304
1983	15.728	17.049	18.938
1984	16.862	18.467	20.7
1985	18.09	20.	22.601
1986	19.418	21.656	24.65
1987	20.857	23.447	26.854
1988	22.414	25.382	29.225
1989	24.1	27.474	31.779
1990	25.926	29.734	34.352
1991	27.904	32.177	37.022

Phoenix

	Low	Most Likely	High
1978	0.171	0.174	0.178
1979	0.183	0.189	0.198
1980	0.196	0.205	0.218
1981	0.209	0.222	0.241
1982	0.224	0.24	0.264
1983	0.24	0.26	0.289
1984	0.257	0.282	0.316
1985	0.276	0.305	0.345
1986	0.296	0.331	0.376
1987	0.318	0.358	0.41
1988	0.342	0.388	0.446
1989	0.368	0.419	0.485
1990	0.396	0.454	0.524
1991	0.426	0.491	0.565

Pittsburgh

	Low	Most Likely	High
1978	0.685	0.696	0.713
1979	0.732	0.755	0.79
1980	0.783	0.818	0.874
1981	0.837	0.887	0.964
1982	0.896	0.961	1.057
1983	0.96	1.041	1.157
1984	1.03	1.128	1.264
1985	1.105	1.221	1.38
1986	1.186	1.323	1.505
1987	1.274	1.432	1.64
1988	1.369	1.55	1.785
1989	1.472	1.678	1.941
1990	1.583	1.816	2.098
1991	1.704	1.965	2.261

St. Louis

	Low	Most Likely	High
1978	0.171	0.174	0.178
1979	0.183	0.189	0.198
1980	0.196	0.205	0.218
1981	0.209	0.222	0.241
1982	0.224	0.24	0.264
1983	0.24	0.26	0.289
1984	0.257	0.282	0.316
1985	0.276	0.305	0.345
1986	0.296	0.331	0.376
1987	0.318	0.358	0.41
1988	0.342	0.388	0.446
1989	0.368	0.419	0.485
1990	0.396	0.454	0.524
1991	0.426	0.491	0.565

San Francisco

	Low	Most Likely	High
1978	29.205	29.674	30.394
1979	31.2	32.176	33.68
1980	33.357	34.88	37.234
1981	35.689	37.803	41.076
1982	38.211	40.963	45.044
1983	40.94	44.379	49.296
1984	43.893	48.07	53.884
1985	47.089	52.06	58.831
1986	50.547	56.373	64.165
1987	54.291	61.034	69.902
1988	58.344	66.071	76.073
1989	62.734	71.515	82.721
1990	67.487	77.399	89.42
1991	72.635	83.759	96.371

San Juan

	Low	Most Likely	High
1978	8.736	8.876	9.092
1979	9.333	9.624	10.074
1980	9.978	10.433	11.137
1981	10.675	11.308	12.287
1982	11.43	12.253	13.474
1983	12.246	13.275	14.745
1984	13.129	14.379	16.118
1985	14.085	15.572	17.598
1986	15.12	16.862	19.193
1987	16.24	18.256	20.909
1988	17.452	19.763	22.755
1989	18.765	21.392	24.744
1990	20.187	23.152	26.747
1991	21.727	25.054	28.826

Seattle-Tacoma

	Low	Most Likely	High
1978	13.875	14.097	14.439
1979	14.822	15.286	16.
1980	15.847	16.57	17.689
1981	16.955	17.959	19.514
1982	18.153	19.46	21.399
1983	19.45	21.083	23.419
1984	20.852	22.837	25.599
1985	22.371	24.732	27.949
1986	24.014	26.781	30.483
1987	25.792	28.995	33.208
1988	27.718	31.389	36.14
1989	29.803	33.975	39.299
1990	32.061	36.77	42.481
1991	34.507	39.792	45.783

Tampa/St. Petersburg

	Low	Most Likely	High
1978	0.942	0.957	0.98
1979	1.006	1.038	1.086
1980	1.076	1.125	1.201
1981	1.151	1.219	1.325
1982	1.233	1.321	1.453
1983	1.321	1.432	1.59
1984	1.416	1.551	1.738
1985	1.519	1.679	1.898
1986	1.631	1.818	2.07
1987	1.751	1.969	2.255
1988	1.882	2.131	2.454
1989	2.024	2.307	2.668
1990	2.177	2.497	2.885
1991	2.343	2.702	3.109

Washington DC

	Low	Most Likely	High
1978	3.34	3.394	3.476
1979	3.568	3.68	3.852
1980	3.815	3.989	4.258
1981	4.082	4.324	4.698
1982	4.37	4.685	5.152
1983	4.682	5.076	5.638
1984	5.02	5.498	6.163
1985	5.385	5.954	6.728
1986	5.781	6.447	7.339
1987	6.209	6.98	7.995
1988	6.673	7.557	8.7
1989	7.175	8.179	9.461
1990	7.718	8.852	10.227
1991	8.307	9.579	11.022

FORECASTED IMPORTS OF AIR CARGO FOR SELECTED HUBS
(000 tons)

Atlanta

	Low	Most Likely	High
1978	0.233	0.237	0.244
1979	0.248	0.256	0.27
1980	0.263	0.276	0.298
1981	0.299	0.317	0.35
1982	0.337	0.363	0.403
1983	0.371	0.403	0.45
1984	0.4	0.44	0.493
1985	0.443	0.491	0.552
1986	0.477	0.535	0.604
1987	0.512	0.579	0.656
1988	0.546	0.624	0.709
1989	0.588	0.678	0.772
1990	0.627	0.728	0.832
1991	0.677	0.792	0.906

Boston

	Low	Most Likely	High
1978	19.742	20.069	20.63
1979	20.984	21.669	22.856
1980	22.26	23.333	25.214
1981	25.281	26.842	29.611
1982	28.573	30.694	34.095
1983	31.435	34.156	38.121
1984	33.887	37.236	41.757
1985	37.47	41.575	46.772
1986	40.409	45.282	51.129
1987	43.359	49.055	55.578
1988	46.255	52.823	60.043
1989	49.824	57.38	65.387
1990	53.069	61.64	70.432
1991	57.291	67.038	76.741

Chicago

	Low	Most Likely	High
1978	49.745	50.568	51.98
1979	52.874	54.598	57.589
1980	56.089	58.793	63.53
1981	63.701	67.633	74.611
1982	71.994	77.338	85.908
1983	79.207	86.062	96.054
1984	85.384	93.824	105.214
1985	94.414	104.755	117.852
1986	101.818	114.097	128.83
1987	109.251	123.604	140.04
1988	116.547	133.097	151.289
1989	125.541	144.58	164.755
1990	133.718	155.314	177.466
1991	144.355	168.915	193.363

Cleveland

	Low	Most Likely	High
1978	0.155	0.158	0.162
1979	0.165	0.171	0.18
1980	0.175	0.184	0.199
1981	0.199	0.211	0.233
1982	0.225	0.242	0.268
1983	0.248	0.269	0.3
1984	0.267	0.293	0.329
1985	0.295	0.327	0.368
1986	0.318	0.357	0.403
1987	0.341	0.386	0.438
1988	0.364	0.416	0.473
1989	0.392	0.452	0.515
1990	0.418	0.485	0.555
1991	0.451	0.528	0.604

Dallas/Ft. Worth

	Low	Most Likely	High
1978	1.088	1.106	1.137
1979	1.157	1.194	1.26
1980	1.227	1.286	1.39
1981	1.393	1.479	1.632
1982	1.575	1.692	1.879
1983	1.733	1.883	2.101
1984	1.868	2.052	2.302
1985	2.065	2.292	2.578
1986	2.227	2.496	2.818
1987	2.39	2.704	3.063
1988	2.549	2.911	3.309
1989	2.746	3.163	3.604
1990	2.925	3.397	3.882
1991	3.158	3.695	4.23

Denver

	Low	Most Likely	High
1978	0.311	0.316	0.325
1979	0.33	0.341	0.36
1980	0.351	0.367	0.397
1981	0.398	0.423	0.466
1982	0.45	0.483	0.537
1983	0.495	0.538	0.6
1984	0.534	0.586	0.658
1985	0.59	0.655	0.737
1986	0.636	0.713	0.805
1987	0.683	0.773	0.875
1988	0.728	0.832	0.946
1989	0.785	0.904	1.03
1990	0.836	0.971	1.109
1991	0.902	1.056	1.209

Detroit

	Low	Most Likely	High
1978	8.472	8.612	8.853
1979	9.005	9.299	9.808
1980	9.553	10.013	10.82
1981	10.849	11.519	12.707
1982	12.261	13.172	14.631
1983	13.49	14.657	16.359
1984	14.542	15.979	17.919
1985	16.08	17.841	20.072
1986	17.341	19.432	21.941
1987	18.607	21.051	23.851
1988	19.849	22.668	25.766
1989	21.381	24.624	28.06
1990	22.774	26.452	30.225
1991	24.586	28.768	32.932

Honolulu

	Low	Most Likely	High
1978	7.695	7.822	8.041
1979	8.179	8.446	8.908
1980	8.676	9.094	9.827
1981	9.854	10.462	11.541
1982	11.137	11.963	13.289
1983	12.252	13.313	14.858
1984	13.208	14.513	16.275
1985	14.605	16.204	18.23
1986	15.75	17.649	19.928
1987	16.9	19.12	21.662
1988	18.028	20.588	23.402
1989	19.42	22.365	25.486
1990	20.684	24.025	27.452
1991	22.33	26.129	29.911

Houston

	Low	Most Likely	High
1978	3.731	3.793	3.899
1979	3.966	4.095	4.319
1980	4.207	4.409	4.765
1981	4.778	5.072	5.596
1982	5.4	5.8	6.443
1983	5.94	6.455	7.204
1984	6.404	7.037	7.891
1985	7.081	7.857	8.839
1986	7.636	8.557	9.662
1987	8.194	9.27	10.503
1988	8.741	9.982	11.347
1989	9.416	10.843	12.357
1990	10.029	11.649	13.31
1991	10.827	12.669	14.502

Kansas City

	Low	Most Likely	High
1978	7.7726E-02	7.9013E-02	8.1219E-02
1979	8.2616E-02	8.5310E-02	8.9983E-02
1980	8.7639E-02	9.1863E-02	9.9266E-02
1981	0.1	0.106	0.117
1982	0.112	0.121	0.134
1983	0.124	0.134	0.15
1984	0.133	0.147	0.164
1985	0.148	0.164	0.184
1986	0.159	0.178	0.201
1987	0.171	0.193	0.219
1988	0.182	0.208	0.236
1989	0.196	0.226	0.257
1990	0.209	0.243	0.277
1991	0.226	0.264	0.302

Los Angeles

	Low	Most Likely	High
1978	79.281	80.593	82.844
1979	84.268	87.016	91.782
1980	89.392	93.701	101.251
1981	101.524	107.79	118.911
1982	114.741	123.257	136.916
1983	126.235	137.161	153.086
1984	136.081	149.532	167.686
1985	150.472	166.954	187.827
1986	162.273	181.843	205.323
1987	174.118	196.994	223.189
1988	185.747	212.123	241.116
1989	200.081	230.424	262.578
1990	213.112	247.532	282.837
1991	230.066	269.209	308.173

Miami/Ft. Lauderdale

	Low	Most Likely	High
1978	91.251	92.761	95.352
1979	96.991	100.154	105.639
1980	102.888	107.848	116.538
1981	116.852	124.064	136.865
1982	132.064	141.867	157.587
1983	145.294	157.869	176.199
1984	156.626	172.108	193.003
1985	173.19	192.16	216.185
1986	186.773	209.297	236.322
1987	200.407	226.736	256.886
1988	213.792	244.15	277.52
1989	230.289	265.213	302.223
1990	245.288	284.905	325.539
1991	264.802	309.854	354.701

Minneapolis/St. Paul

	Low	Most Likely	High
1978	1.321	1.343	1.381
1979	1.404	1.45	1.53
1980	1.49	1.562	1.688
1981	1.692	1.797	1.982
1982	1.912	2.054	2.282
1983	2.104	2.286	2.551
1984	2.268	2.492	2.795
1985	2.508	2.783	3.13
1986	2.705	3.031	3.422
1987	2.902	3.283	3.72
1988	3.096	3.535	4.019
1989	3.335	3.84	4.376
1990	3.552	4.126	4.714
1991	3.834	4.487	5.136

New Orleans

	Low	Most Likely	High
1978	3.109	3.161	3.249
1979	3.305	3.412	3.599
1980	3.506	3.675	3.971
1981	3.981	4.227	4.663
1982	4.5	4.834	5.369
1983	4.95	5.379	6.003
1984	5.336	5.864	6.576
1985	5.901	6.547	7.366
1986	6.364	7.131	8.052
1987	6.828	7.725	8.753
1988	7.284	8.319	9.456
1989	7.846	9.036	10.297
1990	8.357	9.707	11.092
1991	9.022	10.557	12.085

New York

	Low	Most Likely	High
1978	363.138	369.149	379.457
1979	385.982	398.568	420.398
1980	409.451	429.186	463.771
1981	465.018	493.722	544.66
1982	525.556	564.567	627.127
1983	578.207	628.25	701.194
1984	623.302	684.915	768.065
1985	689.219	764.712	860.319
1986	743.272	832.911	940.458
1987	797.529	902.31	1022.29
1988	850.795	971.607	1104.41
1989	916.449	1055.43	1202.71
1990	976.138	1133.79	1295.5
1991	1053.79	1233.08	1411.55

Philadelphia/Camden

	Low	Most Likely	High
1978	9.327	9.482	9.746
1979	9.914	10.237	10.798
1980	10.517	11.024	11.912
1981	11.944	12.681	13.99
1982	13.499	14.501	16.108
1983	14.851	16.137	18.01
1984	16.009	17.592	19.728
1985	17.703	19.642	22.097
1986	19.091	21.393	24.156
1987	20.484	23.176	26.258
1988	21.853	24.956	28.367
1989	23.539	27.109	30.892
1990	25.072	29.121	33.275
1991	27.067	31.672	36.256

Phoenix

	Low	Most Likely	High
1978	0.155	0.158	0.162
1979	0.165	0.171	0.18
1980	0.175	0.184	0.199
1981	0.199	0.211	0.233
1982	0.225	0.242	0.268
1983	0.248	0.269	0.3
1984	0.267	0.293	0.329
1985	0.295	0.327	0.368
1986	0.318	0.357	0.403
1987	0.341	0.386	0.438
1988	0.364	0.416	0.473
1989	0.392	0.452	0.515
1990	0.418	0.485	0.555
1991	0.451	0.528	0.604

Pittsburgh

	Low	Most Likely	High
1978	0.311	0.316	0.325
1979	0.33	0.341	0.36
1980	0.351	0.367	0.397
1981	0.398	0.423	0.466
1982	0.45	0.483	0.537
1983	0.495	0.538	0.6
1984	0.534	0.586	0.658
1985	0.59	0.655	0.737
1986	0.636	0.713	0.805
1987	0.683	0.773	0.875
1988	0.728	0.832	0.946
1989	0.785	0.904	1.03
1990	0.836	0.971	1.109
1991	0.902	1.056	1.209

St. Louis

	Low	Most Likely	High
1978	0.466	0.474	0.487
1979	0.496	0.512	0.54
1980	0.526	0.551	0.596
1981	0.597	0.634	0.699
1982	0.675	0.725	0.805
1983	0.743	0.807	0.901
1984	0.8	0.88	0.986
1985	0.885	0.982	1.105
1986	0.955	1.07	1.208
1987	1.024	1.159	1.313
1988	1.093	1.248	1.418
1989	1.177	1.355	1.545
1990	1.254	1.456	1.664
1991	1.353	1.584	1.813

San Francisco

	Low	Most Likely	High
1978	55.263	56.178	57.747
1979	58.74	60.655	63.978
1980	62.312	65.315	70.578
1981	70.768	75.136	82.888
1982	79.981	85.918	95.438
1983	87.994	95.609	106.71
1984	94.856	104.233	116.887
1985	104.888	116.376	130.926
1986	113.114	126.755	143.122
1987	121.371	137.316	155.576
1988	129.477	147.862	168.072
1989	139.468	160.619	183.033
1990	148.552	172.544	197.154
1991	160.37	187.654	214.814

San Juan

	Low	Most Likely	High
1978	21.297	21.65	22.254
1979	22.637	23.375	24.655
1980	24.013	25.171	27.199
1981	27.272	28.955	31.943
1982	30.822	33.11	36.779
1983	33.91	36.845	41.123
1984	36.555	40.168	45.045
1985	40.421	44.848	50.455
1986	43.591	48.848	55.155
1987	46.773	52.918	59.955
1988	49.897	56.982	64.77
1989	53.747	61.898	70.536
1990	57.248	66.494	75.978
1991	61.802	72.317	82.784

Seattle-Tacoma

	Low	Most Likely	High
1978	12.98	13.195	13.564
1979	13.797	14.247	15.027
1980	14.636	15.341	16.577
1981	16.622	17.648	19.469
1982	18.786	20.18	22.417
1983	20.668	22.457	25.064
1984	22.28	24.482	27.454
1985	24.636	27.335	30.752
1986	26.568	29.772	33.617
1987	28.508	32.253	36.542
1988	30.412	34.73	39.477
1989	32.758	37.726	42.991
1990	34.892	40.527	46.308
1991	37.668	44.076	50.456

Tampa/St. Petersburg

	Low	Most Likely	High
1978	0.233	0.237	0.244
1979	0.248	0.256	0.27
1980	0.263	0.276	0.298
1981	0.299	0.317	0.35
1982	0.337	0.363	0.403
1983	0.371	0.403	0.45
1984	0.4	0.44	0.493
1985	0.443	0.491	0.552
1986	0.477	0.535	0.604
1987	0.512	0.579	0.656
1988	0.546	0.624	0.709
1989	0.588	0.678	0.772
1990	0.627	0.728	0.832
1991	0.677	0.792	0.906

Washington DC

	Low	Most Likely	High
1978	4.508	4.583	4.711
1979	4.792	4.948	5.219
1980	5.083	5.328	5.757
1981	5.773	6.129	6.762
1982	6.524	7.009	7.785
1983	7.178	7.799	8.705
1984	7.738	8.503	9.535
1985	8.556	9.493	10.68
1986	9.227	10.34	11.675
1987	9.901	11.202	12.691
1988	10.562	12.062	13.711
1989	11.377	13.103	14.931
1990	12.118	14.075	16.083
1991	13.082	15.308	17.524

APPENDIX B - WORLD REGIONS AND CONSTITUTENT COUNTRIES

Data for air cargo tonnages from the Commerce Department's publications classifies the world into six regions: (1) North America, (2) South America, (3) Europe, (4) Asia, (5) Oceania and Australia, and (6) Africa. Description of these areas can be found in the Department of Commerce, "Guide to Foreign Trade Statistics." For the purpose of this study, statistics were gathered for a total of 73 nations, listed below, in order to develop reasonable estimates of regional economic activity. This list excludes some of the nations comprising the Commerce Department regions due to lack of available data. Data was collected for GDP and exchange rates from the IMF, International Financial Statistics, various volumes. For this study the six regions are comprised of the following nations:

I. North America:
   1. Canada
   2. Costa Rica
   3. Dominican Republic
   4. El Salvador
   5. Guatemala
   6. Honduras
   7. Jamaica
   8. Nicaragua
   9. Trinidad and Tobago

10. Mexico
11. Panama

II. South America:
1. Argentina
2. Bolivia
3. Brazil
4. Columbia
5. Chile
6. Ecuador
7. Paraguay
8. Peru
9. Venezuela
10. Guyana

III. Europe:
1. Belguim
2. France
3. West Germany
4. Italy
5. Netherlands
6. Austria
7. Denmark
8. Norway
9. Portugal

10. Sweden
11. Switzerland
12. United Kingdom
13. Finland
14. Greece
15. Iceland
16. Ireland
17. Spain

IV. Asia:

1. Ceylon (Sri Lanka)
2. China (Taiwan)
3. India
4. Iran
5. Japan
6. Korea
7. Malaysia
8. Pakistan
9. Philippines
10. Singapore
11. Thailand
12. Kuwait
13. Israel
14. Iraq
15. Indonesia
16. Jordan