meetings are informal working sessions; 23 percent are formal information exchanges. Sales calls are a relatively small part. The high proportion of routine, informal meetings explains why so many early users are no longer concerned about behavioral acceptability. Meetings with much necessary interpersonal contact, such as delicate negotiations and first time meetings with clients, are not suggested for teleconferencing, but they are a small part of the total.

Almost nine-tenths of teleconferences at IBM are two hours or less. The average length of a meeting at IBM that involves travel is about four hours. This supports the general belief that teleconferences are much shorter than the face-to-face meetings they replace. This affects, and is affected by, the economics. Users are aware that the clock is running.

IBM found that 88 percent of the people said they were either very satisfied or moderately satisfied with teleconferencing. Another question was whether they would use teleconferencing again for this type of meeting. More than three-quarters said yes. If teleconferencing had not been available, two-thirds said they would have travelled. This suggests that many teleconferences do not substitute for trips, but rather represent additional communications. Finally, IBM asked users what was the greatest advantage. Time saving was rated more important than anything else.

What of the potential impact on air travel? SRI International (SRI) did a large study for the National Science Foundation and the Department of Energy called a Technology Assessment. The purpose was to assess the societal impacts which might occur if there were some change in the balance between transportation and telecommunications. Much of the emphasis was on urban commuting, the need for rail transit, and so forth. Part dealt with long range air travel.

The approach was to postulate some "what if" scenarios. One of them assumed that telecommunications substituted for 20 percent of business travel. The task was to estimate some of the impacts on the aviation industry. Some people have claimed recently that SRI concluded teleconferencing will substitute for 20 percent of business air travel. That is incorrect. SRI did say that 20 percent substitution was felt to be realistic based on research and logic. There was another scenario assuming business travel would increase 20 percent. This 20 percent generation was purely arbitrary since there was no logic to go on. The object was of course to do a sensitivity analysis.

A 1976 version of Air Transport Association statistics for revenue passenger emplanements projected growth out to the year 2000. About half of that travel was for business. A wedge showing a 20 percent net substitution for business travel would mean a slightly slower growth rate for air travel. That 20 percent assumes teleconferencing is ubiquitous, but it is not. Over the next five to ten years many of the Fortune 500 companies will be going in this direction by putting in teleconferencing at half a dozen or a dozen of their major locations. All of the trip origins and destinations are certainly not going to be connected for a long time - only a very small portion of them will be. It will be a long, long time before teleconferencing is everywhere, and that has to be accounted for in any assessment of its impact on travel. The last important point is that the market for teleconferencing can be very large and attrative, while the impact on air travel is still slight.

The SRI report reviews the research into teleconferencing, and gives average trip lengths, meeting durations, and other data. It is available from the National Technology Information Service in Springfield, Virginia. The session numbers are PB 272694, 5 and 6. It is the single summary source for most of the research in this area.

REVIEW AND CRITIQUE OF FAA FORECASTS AND ASSUMPTIONS

Robert W. Simpson, Massachusetts Institute of Technology

General Summary

There were three presentations - one on data sources; one on a new general aviation (GA) forecasting model; and an overview of FAA's air carrier forecasting model.

The FAA uses Wharton Econometrics, Data Resources Inc., and others for national economic data, CAB data, and FAA internal reports of air traffic control. There is also an annual FAA survey of general aviation activity and avionics.

Methods were presented to give aggregate national activity by general aviation aircraft. The models are now made sensitive to fuel prices, and indicate a temporary decline in GA activity over the next few years. Some inputs on fuel prices and consumer prices cause the decline. Increasing GA activity is indicated after 1982 or 1983. However, the model presented has a rather low "R-square" of .65. Discussion brought out that there is disagreement on the value of aggregate economic indicators such as GNP. Whether or not such indicators should be employed is still unresolved.

The advisability of having a point estimate, a single estimate of the forecast numbers, or high and low estimates, was discussed. Some participants advocated a measure of the uncertainty of the forecast, particularly over longer time periods.

The FAA reviewed their techniques of air carrier forecasting. Results indicate a 4.5 percent annual growth in revenue passenger miles and slow growth in airline operations. Operations have declined in recent years, but growth is expected to resume during the 1980's. Though impressive on a chart, the growth is only about 20 percent by 1990 for total U.S. airline operations.

Some discussion disparaged reliance on mathematical econometric models. Other techniques, judgmental or consensus-seeking kinds of activity, were proposed, and a variety of several techniques advocated. Perhaps a variety of sources of forecasts should be examined. It was also suggested that aggregate models should be broken down into component quantities, and other factors of one kind or another introduced into the component analysis. Results might be better in forecasting component parts, rather than aggregates.

FAA Presentation and Discussion

Gene Mercer, FAA

First, we present our forecasting models and discuss our assumptions on exogenous variables and how they affect our results. We would like a thorough discussion of our theoretical structures, inputs, and assumptions. These discussions are valuable to us, because we rely heavily upon industry inputs for developing and refining our models and assumptions. Charles Moles will discuss our sources, Arnold Schwartz will present our new general aviation forecasting model, and Robert Bowles will discuss our air carrier model.

Charles Moles, FAA

FAA forecasts cover four areas: commercial air carrier traffic; general aviation; FAA workload; and military aviation. Key economic indicators are taken from the Wharton model, but Chase, DRI, Evans, and Office of Management and Budget data are also employed.

The Civil Aeronautics Board is of course the data source for air carrier traffic. For general aviation, FAA is the source, with our annual General Aviation (GA) Activity and Avionic Survey, and active pilot certificates. For military aviation the source is the Department of Defense. FAA workload data are also, of course, available and are collected by type of air traffic facility, that is air route traffic control centers, airport traffic control towers, and flight service stations.

Arnold Schwartz, FAA

A major reason for developing a new general aviation model was the instability of the old model's coefficients. Also, the great rise in fuel prices prompted an effort to develop more accurate estimates of the impact of such changes.

The model is a set of regression equations derived from twenty years of historical data. National economic variables are related to general aviation activity. Equations were developed for the fleet, and FAA workload measures at towers, air route traffic control centers, and flight service stations. Projections are made by putting into our equations forecasts of the exogenous variables.

The active fleet is of course the prime driver of all activity. To forecast the total active fleet, the approach is to define a demand function in terms of the change in the fleet, and then to estimate the fleet by adding the incremental estimates to the total. The change in the fleet is business aircraft plus personal aircraft purchased during the period, minus attrition, plus aircraft moving from inactive to active status, minus aircraft moving from active to inactive status. The only variable we actually observe during the period is the change in the fleet; we do not have estimates for the other variables. (Figure 1)

The demand for business aircraft depends on the real price of the aircraft, the rate of interest, and some measure of business activity. The demand for personal flying also is a function of the real price of the aircraft, the rate of interest, and some measure of income. For income Real Gross National Product is employed, and the measure of business activity is total manufacturing and retail sales, lagged one period. The interest rate is the long term rate, and aircraft prices are deflated by the implicit GNP price deflator. All these independent variables influence the change in the fleet.

Figure 2 shows results. All variables have the correct signs. A trend variable is in the equation to account for all other factors for which no measures are available. Here the trend indicates a declining change of the fleet. All coefficients are significant, and Durbin-Watson shows no autocorrelation. The R-square is .65. The residuals follow a normal distribution. The elasticities for the equation are: one percent increase in GNP increases the change in the fleet by 17 percent; one percent increase in the relative price of aircraft reduces the change in the fleet by four percent; one percent increase in the interest rate reduces the change in the fleet by two percent; one percent increase in sales in the previous year increases the change in the fleet by three percent; and over time with all of the variables held constant in the equation, the change in the fleet declines.

For student demand, it is assumed that student pilots are a funciton of income and the relative cost of flying. Income is measured by real GNP, and the real cost of flying is measured by the fuel index relative to the GNP Price Deflator. For the estimated equation, the sign for GNP is positive as expected, and the price variable has a negative sign. Both coefficients are significant and the R-square is high. The Durbin-Watson statistics show no autocorrelation. Income elasticity indicates that a one percent increase in GNP increases the number of students by 1.13 percent; and a one percent increase in the relative price of fuel reduces the number of students by .22 percent.

Figure 3 gives the equations developed for the tower workload measures. Itinerant operations are a function of the fleet size, and the relative price of fuel. Local operations are a function of the number of students and the fleet. Instrument operations are simply a funciton of the number of active aircraft. All variables have the correct signs, R-squares are very high, and all the F values are significant. Also, the Durbin-Watson statistics indicate no problems with autocorrelation.
Figure 4 shows the elasticities for the variables.

For the air route traffic control centers we estimate IFR departures and IFR overs. IFR departures are a function of the fleet, and IFR overs are a function of departures. Both equations have R-squares of .99, very high F values, no autocorrelation, and have normally distributed residuals.

For flight service station workload equations, aircraft contacted is a function of itinerant operations. Pilot briefs, VFR and IFR flight plans

Figure 1. General aviation active fleet model.

$$f_{t+1} - f_t = S^B_{t+1} + S^P_{t+1} - X_{t+1} + A_{t+1} - I_{t+1} \qquad (1)$$

$$\hat{f}_{t+1} = f_t + \Delta\hat{f}_{t+1} \qquad (2)$$

Where:

$f_{t+1} - f_t$ = **Change in Active Fleet,**
S^B = **Sales of Business Aircraft,**
S^P = **Sales of Personal Aircraft,**
X = **Attrition,**
A = **Inactive to Active Status, and**
I = **Active to Inactive Status.**

Figure 2. General aviation active fleet demand equation.

Change in Fleet =

$$\begin{aligned} -1{,}055{,}840 &+ 125043 \text{ Log GNP} \\ &\quad (4.8) \\ &+ 22191 \text{ Log Sales } (-1) \\ &\quad (1.5) \\ &- 11794 \text{ Log Interest} \\ &\quad (1.5) \\ &- 31680.9 \text{ Log } \frac{\text{Price Index}}{\text{GNP Deflator}} \\ &\quad (2.4) \\ &- 4313.6 \text{ Time} \\ &\quad (2.2) \end{aligned}$$

$\hat{R}^2 = .65 \qquad F = 7.3 \qquad D.W. = 2.0$

Figure 3. General aviation tower workload equations.

$$\text{Itinerant Operations} = 2.26 + \underset{(8.7)}{.16\ \text{Fleet}} - \underset{(2.9)}{3.82}\ \frac{\text{Fuel Price Index}}{\text{Implicit GNP Deflator}}$$

$\bar{R}^2 = .98$ $F = 408.8$ $D.W. = 1.6$

$$\text{Local Operations} = -4.04 + \underset{(5.6)}{.10\ \text{Students}} + \underset{(1.4)}{.03\ \text{Fleet}}$$

$\bar{R}^2 = .98$ $F = 484.4$ $D.W. = 1.0$

$$\text{Instrument Operations} = -3.61 + \underset{(11.03)}{.06\ \text{Fleet}}$$

$R^2 = .92$ $F = 121.7$ $D.W. = 1.7$

Figure 4. General aviation tower workload equations: interpretation of results.

Tower Workload Equations: Interpretation of Results

- 1% Increase in the Active Fleet Increased Itinerant Operations by 1.07%
- 1% Increase in the Relative Price of Fuel Reduced Itinerant Operations by .23%
- 1% Increase in Students Increased Local Operations by 1%
- 1% Increase in the Fleet Increased Local Operations by .21%
- 1% Increase in the Fleet Increased Instrument Operations by 1.5%

Figure 5. General aviation flight service station workload equations: interpretations of results.

- **1% Increase in Itinerant Operations Increased Aircraft Contacted 1.1%**
- **1% Increase in the Fleet Increased Pilot Briefs 1.6%**
- **1% Increase in the Relative Price of Fuel Reduced Pilot Briefs .3%**
- **1% Increase in the Fleet Increased VFR Flight Plans Filed by .6% and IFR Flight Plans Filed by 1.6%**
- **1% Increase in the Relative Price of Fuel Reduced VFR Flight Plans Filed by .27% and IFR Flight Plans Filed by .21%**

Figure 6. Annual percent change in GNP (72 $).

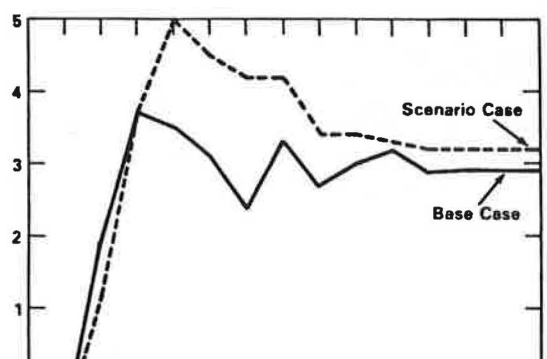


Figure 7. Annual percent change oil and gas deflator (72 $).

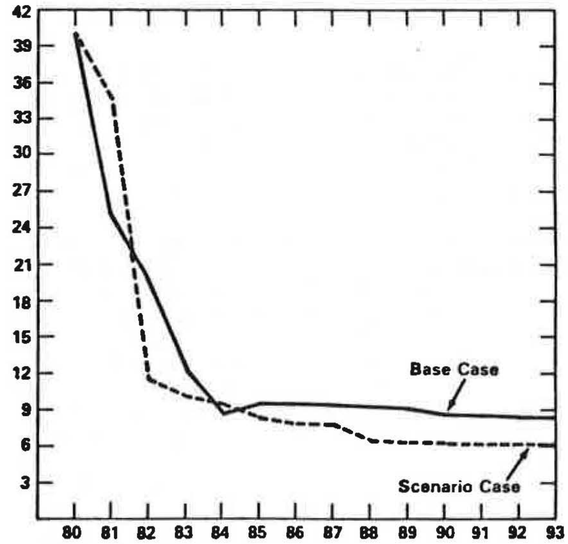
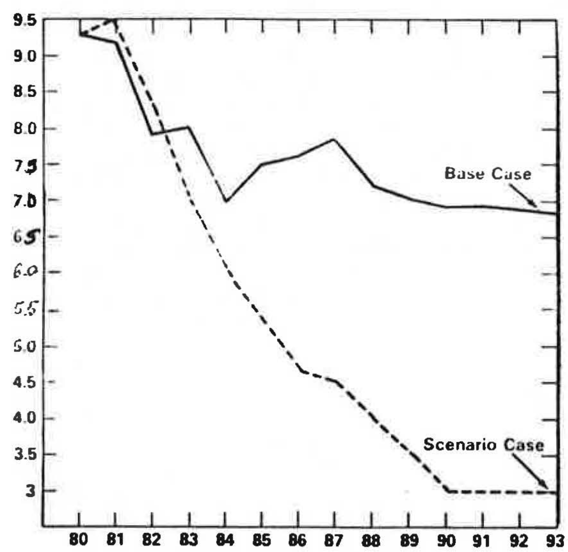


Figure 8. Annual percent change GNP implicit price deflator (72 $).



filed, are specified as functions of fleet size and the relative price of fuel. All variables have the correct signs, R-squares are very high, and all F values are significant. The Durbin-Watson statistics indicate no autocorrelation. Figure 5 interprets these results.

Figures 6, 7, and 8 compare Wharton's November 1980 forecast with the Administration's for the three important exogenous variables used in the GA model. Figure 6 shows the comparison for annual percentage change in GNP ("Scenario" is Administration, "Base" is Wharton). For 1981 Wharton is forecasting an increase of 1.9 percent, and the Administration 1.1 percent. In 1982 Wharton is forecasting a 3.7 percent increase, and the Administration 4.2 percent. The significant difference comes in 1983, when Wharton is forecasting a 3.5 percent increase, and the Administration a 5 percent increase. Both forecasts level off in the latter part of the 1980's, with Wharton's close to 3 percent and the Administration's close to 3.2 percent.

David Raphael

GNP is very important and sensitive, and those differences may make big differences in the results.

Arnold Schwartz

The equations we have developed to forecast general aviation activity are theoretically sound and statistically valid. However, we must rely upon outside sources for forecasts of the exogenous variables. Clearly, accurate estimates of these independent variables are essential for good forecasts.

Figure 7 compares the projected changes for the oil and gas deflator. Both indexes show big declines during the forecast period. Wharton's levels off at about 9 percent, and the Administration's at approximately 6 percent. Figure 8 shows dramatic differences between the forecasts for the GNP implicit price deflator. Both decline during the forecast period with Wharton's leveling off at about 7 percent and the Administration's at about 3 percent.

Both forecasts were used to generate projections of general aviation operations. The results were not so different, because of the counterbalancing effect of the variables. For example, GNP is growing at a faster rate under the Administration's scenario, which tends to increase operations. However, the faster decline in the implicit price deflator in comparison to the decline in the oil price index tends to make gas relatively more expensive, which has a dampening effect on activity.

In conclusion, the relationships we have developed between measures of aviation activity and the economy are defensible on theoretical grounds, and are statistically significant. Our analyses also provide us with a good idea of the magnitude and direction of errors in the equations. However, in developing projections, we must rely upon forecasts of exogenous variables whose errors are uncontrollable by us and unknown to us. The compounding of errors can be significant, and techniques for controlling and measuring them must be pursued if we are to improve our work.

David Raphael

I am concerned about using GNP. I know the results of trying to come up with a reasonable equation, trying to make it fit, and explaining it afterwards. There should be less emphasis put on GNP as a forecasting variable, because of the wide variation in GNP forecasts. Its correlation is high, but that is only because it is explaining virtually everything in the equations. The FAA should look for other factors, so that GNP does not drive things so much. This is easy to say but difficult to do. The FAA people would appreciate advice on this. We should think of qualitative adjustments, or judgmental adjustments that can be made. The FAA has called on us to help them formulate new approaches.

Arnold Schwartz

Economic theory tells us which variables are important, and statistical methods enable us to measure their relative effects. We ourselves do not put the emphasis on the GNP. The historical data demonstrates its impact on the dependent variables. All the relevant variables cannot be quantified, so judgment is necessary to adjust for them.

John Drake, Purdue University

Do you have data from Wharton, for example, on the variation of actual GNP about their forecasts? The measure of uncertainty should be available. Then instead of a point forecast you could deliver your forecast in the form of an uncertainty distribution. That would make clear that the influential GNP variable is itself rather shaky. But do not make a point forecast out of a wide distribution.

Arnold Schwartz

We do perform sensitivity analyses by varying the exogenous variables about their means and evaluating the effects. However, we do need point estimates for determining future manpower requirements and capital needs.

John Drake

But are you not responsible for showing the distribution - how far off you can be?

Gene Mercer

We have to go to Congress and request manpower and facilities, based upon our forecasts. We do explain that the forecasts are point estimates and subject to error. Congress asks such questions as "How accurate have your short term forecasts been in the past?" For budget year forecasts -- they have proved adequate. We went to the scenario concept because we are concerned about the longer term. The forecast errors are larger, and expenditure of significant amounts of money are being planned. Examples are the new enroute air traffic control system, and the radar systems. We want Congress to understand that there is uncertainty, and that this uncertainty must be considered.

David Bluestone

David Raphael's point is well taken, but hard to meet. Aviation activity depends upon the general economy, whether you call it GNP or something else. Aviation activity, like most other activities, swings up or down with the general economy. I see no way out of the uncertainty problem for FAA. They have to make a point forecast, make requests to Congress, and then build, and hire particular numbers of people for a particular workload. Forecasters always put in high, low, and probable numbers. Those who later judge us always omit those. Congress will criticize FAA for any errors, retrospectively, but will refuse to second guess them, prospectively. If they do second guess them, then their guess comes true, because FAA cannot provide the capacity and the personnel to carry out the unconstrained forecast. Whether you protect yourself by putting in high, low, probable, or whatever, you will later nevertheless be held to account for your point forecast.

David Lawrence, Sikorsky

The FAA forecast is for FAA's guidance. But most of us also use these forecasts, perhaps for reasons that would astonish people. It is important that we understand the bands of uncertainty around these points. We pick little elements within the forecast, and some of these things are shaky, and others are firm. We would like to know which are shaky, and how much.

George Sarames

You might try a market research approach to general aviation. Get a distribution of pilots by age cohorts in different sections of the country. General aviation varies in different parts of the country. The West and the South have a lot more such flying per capita. Relate that to population and markets, not to the national GNP. Try to understand the general aviation market, who is flying, why, and where. The FAA supported some work in the

Tristate Region in 1962, some survey work that demonstrates this approach.

Arnold Schwartz

Though we utilize a highly aggregated model, statistical evaluation indicates that our projections have been very accurate. It is sometimes thought that a micro approach, which is more expensive, will reduce the errors. But in many instances, the opposite appears to be true. The reason is the compounding of errors when summing individual series. In an aggregated approach, the errors tend to cancel out.

Gene Mercer

One of the major reasons for our aggregated approach is the unavailability of data. Though we may have some disaggregated series as sample estimates, they are inconsistent and have large errors.

Nariman Behravesh

Wharton Econometrics Forecasting Associates will reiterate a few points, and defend the FAA. It might appear to make sense to take a specialized portion of GNP for the equations. But using GNP as the general level of economic activity picks up more of the feedbacks coming from other sectors. Narrowing the scope of the activity variable may be missing information. Thus there is a good argument for using total GNP. Wharton also supports Arnold Schwartz in that components of GNP show more volatility than the total, where the errors tend to offset. A narrow concept might bring more volatility and more uncertainty. From that point of view it is probably better to use total GNP.

Now concerning uncertainty, it might be better to look at the error of predictions of GNP, and then see how that affects the errors in the equations. That could be better than choosing scenarios, which may or may not happen. There may not necessarily be any more uncertainty than in the last decade when there was a lot of uncertainty. The best course is to figure out the extent of errors in the forecast, and then determine the implications for the individual equations.

Robert Bowles, FAA

This is a review of the various assumptions and variables that were employed in last year's air carrier forecasts. Changing conditions in the industry, the general economy, and a change in Administration as well may change the assumptions and variables used in this year's forecasts. Your inputs during this conference will certainly be factors in selecting the assumptions and variables to be used for this year.

In last year's air carrier forecast, the first step was to forecast three operational variables: load factor, average seats per aircraft, and passenger trip length. This starts with an analysis of past trends. What has been the impact of deregulation? What was the impact of the fuel shortages during 1973-74 and 1979? We confer with industry experts to determine why things moved the way they did and what direction they may take in the future. The present conference is one example of the expert input we use. Then we extrapolate the expected trends.

Before deregulation, load factors would have been thought to remain in the mid 50's range. But deregulation and the proliferation of low fares greatly increased traffic during 1978-80, and brought load factors to the low 60's. These trends are expected to continue, and load factors to increase from 61 percent in 1980 to 63 percent in 1984 and thereafter to remain at that level. There is some question on whether 63 percent is an upper limit.

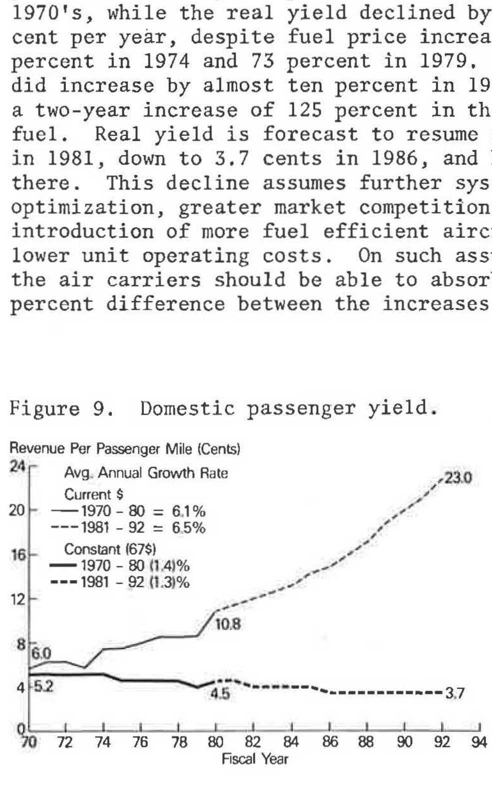
The average number of seats per aircraft has increased by 3.4 seats per year from 1970 to 1980, from 110 to 144. This trend will continue as the industry replaces older aircraft with quieter, larger capacity, and more fuel efficient planes to meet growing traffic demand. The average aircraft is forecast to have 190 seats by 1992.

The average domestic passenger trip length increased from 663 miles in 1970 to 717 miles in 1978. Fourteen miles of this increase occurred between 1977 and 1978, owing largely to deregulation. Some declines in 1979 and 1980 can be attributed to the inclusion of regional and large commuter carriers in the CAB data base. Beginning in 1980, the overall certificated air carrier trip length is forecast to resume its historical growth rate, increasing at a rate of three miles per year, to 733 miles in 1992.

Real or constant dollar passenger yield, defined here as cents per revenue passenger mile, must be forecast. Analysis begins with past trends, discussing these with industry and financial experts, and extrapolating the trends. Two economic variables are analyzed: the consumer price index (CPI) and the oil and gas deflator, since the increasing cost of fuel has become an important pricing factor. The CPI and oil prices followed the same general trend until 1978. Then oil prices rose by 90 percent between 1978 and 1980, while the CPI increased by 26 percent. Wharton projects that CPI will rise annually by nine percent from 1980 to 1985 and by 7.6 percent between 1985 and 1992. Fuel prices are forecast to increase by 12 percent from 1980 to 1985, and nine percent from 1985 to 1992. The real question is whether the airlines can absorb the difference between the fuel price increase and the CPI.

Figure 9 shows the relationship between the constant and current dollar yield. The current yield increased by 6.1 percent annually during the 1970's, while the real yield declined by 1.4 percent per year, despite fuel price increases of 85 percent in 1974 and 73 percent in 1979. Real yield did increase by almost ten percent in 1980, due to a two-year increase of 125 percent in the price of fuel. Real yield is forecast to resume its decline in 1981, down to 3.7 cents in 1986, and holding there. This decline assumes further system optimization, greater market competition, and the introduction of more fuel efficient aircraft with lower unit operating costs. On such assumptions, the air carriers should be able to absorb the two percent difference between the increases in fuel

Figure 9. Domestic passenger yield.



prices and the CPI. Current dollar yield, however, is expected to grow 6.5 percent per year, from 10.8¢ to 22.9¢.

The next step is to forecast air carrier traffic. Three independent variables are used: real yield, disposable personal income (DPI) and a price index for private urban transportation. Real yield is to resume its historical decline beginning in 1981. Real DPI, which increased at an average rate of 3.1 percent between 1970 and 1980, is forecast by Wharton in increase at an average rate of 3.3 percent during the forecast period. The index for private urban transportation, which is an indicator of the cost of automobile travel, a substitute for air travel in short-haul markets, is forecast to grow at an annual rate of 5.8 percent, less than the 8.4 percent rate experienced during the 1970's.

The regression equation used to forecast revenue passenger miles (RPM's) states that scheduled domestic RPM's depend on the three independent variables measured in the 1969-1980 period. With the coefficients, T-statistics, and elasticities of the independent variables shown in Figure 10, it appears that the properties of the regression equation are good and the values statistically significant. This equation is then used to forecast scheduled domestic RPM's to 1992. Although RPM's grew faster in earlier periods, the equation predicts that traffic will grow only 4.8 percent per year during the forecast period, from 202 billion RPM's in 1980 to 353 billion RPM's in 1992.

Once RPM's have been forecast, passenger enplanements are derived from average trip length. The equation is:

Passengers = RPM's / (Average Trip Length / 1000)

Average trip length is forecast to increase by 3.2 miles per year during the forecast period. Enplaned passengers can then be expected to grow less than RPM's, 4.3 percent versus 4.8 percent per year. This is like the trend during the 1970's when enplaned passengers grew by an annual rate of 6.4 percent, compared to an RPM growth rate of 6.9 percent.

The final step is to forecast air carrier activity at FAA facilities. These activity forecasts are in turn used to forecast FAA workloads. Forecasts are generated for five activity measures.

The first activity measure is itinerant operations which are all aircraft operations (other than local within 20 miles of the airport) in controlled or noncontrolled airport terminal areas. The equation is:

Itinerant Operations = 3.1 x (Enplaned Passengers/ (Average seats x Load Factor))

That is, average seats times load factor equals the average number of seats filled on an average flight. Total passengers divided by this number gives the number of flights necessary to carry the passengers. Normally, this would be multiplied by 2, for one takeoff and landing per flight, to arrive at total operations. However, the passenger forecast used in the equation represents scheduled domestic operations only. Therefore, the 3.1 is a calculated factor based upon historical relationships to include international, cargo and supplemental carrier operations. Itinerant operations are to increase from 10.3 million in 1980 to 12.5 million in 1992, an average of 1.6 percent per year. (Figure 11)

Instrument operations are defined as aircraft operations in accordance with an IFR flight plan or where IFR separation between aircraft is provided by a terminal control facility or air route traffic control center. The equation used is:

Instrument Operations = Itinerant Operations + 0.3

The 0.3, in this case, represents a forecast average of the historical relationship between itinerant operations and instrument operations. Instrument operations are projected to increase from 10.6 million in 1980 to 12.8 million in 1992.

The third measure, IFR departures, are flights that are: (1) originating in an air route traffic control center's area; (2) extended by the center; or (3) accepted by the center under sole en route clearance procedures. The equation used is:

Departures = (Itinerant Operations - 0.2) /2

Departures are forecast to increase from 5.0 million in 1980 to 6.2 in 1992. The 0.2 which is subtracted is a factor, based upon a historical relationship, to eliminate takeoffs occurring at noncontrolled airport terminal areas.

A fourth measure, IFR overs, are IFR flights originating outside the Air Route Traffic Control Area and passing through the area without landing. The equation used to derive overs is:

Overs = 0.75 x Departures

The 0.75 is the forecast value assigned to the historical relationship between departures and overs. IFR overs are forecast to increase from 3.9 million in 1980 to 4.6 million in 1992. (Figure 12)

The final measure, IFR aircraft handled, is the number of IFR departures multiplied by two (departures plus landings) plus the number of IFR overs. This equation gives a forecast of 17.0 million aircraft handled in 1992.

Figure 10. RPM forecast model.

RPM's = F ('Real' Yield   Disposable Income   Transportation Index)
1969 1979

Dependent Variable: RPM

Variable	Coefficient	T-Statistic	Mean	Elasticity
Constant	88.2337	1.80768	1.0000	
Yield	-22.5606	-4.47729	5.32058	-1.06176
DPI	.129640	3.69723	770.812	.883905
Index	.344881	5.89798	130.268	.397397

R-Squared: 0.994 (Uncorrected)   R-Squared: 0.993 (Corrected)

Figure 11. Air carrier operations at airports with FAA traffic control service.

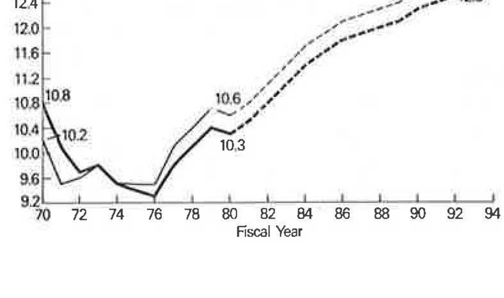
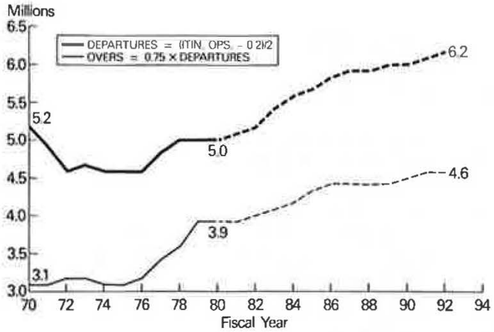


Figure 12. IFR departures and overs at FAA air route traffic control centers.



This concludes the review of the assumptions and variables used to forecast air carrier activity for 1981-1992. These traffic and activity forecasts are not, by any means, all of the FAA's air carrier forecasts. A few of the others, generated annually, are: international RPM's and enplaned passengers, air cargo forecasts, air carrier fleet forecasts, air carrier fuel consumption forecasts, and forecasts of airborne hours by aircraft type.

William Nesbit

I have two comments. Projecting to 1992, we should show simple lines going out there. Show them as trends; no one can forecast cyclical wiggles. Some of them may not be straight lines, because of different kinds of growth rates. Second, the FAA should continue their practice of a number of years of consulting with the air carriers, and with the Air Transport Association, on the reasonability of these assumptions. The econometric model is a mere routine because all the inputs are judgmental, and will continue to be so, whether GNP or DPI, or passenger trip length, or load factor. These are judgmental, and you need as many people's judgment as possible. When testifying one needs a lot of equations, but all the inputs require good judgment, and you have to go to the people who can make those judgments.

George Sarames

I second those comments. Some changes are needed to improve the forecasts. This aggregate approach from GNP to traffic is 35 years old and is now useless. In the last few years the economy has changed, the world of aviation has changed, and the historical series are meaningless. To treat U.S. air traffic, one-third of the world's total, as one homogeneous market is ridiculous. An RPM that represents New York-Florida is different from an RPM that represents New York-Washington or New York-Los Angeles. It is time to disaggregate the total market and look at the pieces. Then we may understnad it, and be able to forecast it. It would be better to have a group of us come together and help with the forecast, than to have econometric models that are meaningless. FAA must spend money, do surveys, and learn what the market is all about. All our forecasts look alike. We all have the same data, and the same econometric models, and they all come out the same way. We are only mutually reinforcing our ignorance. We need a basic change in approach.

Gene Mercer

We agree. In the commuter forecast model being developed through SRI, we look at different markets. Cochise and Air Midwest and Air New England and other commuters are now technically Form 41 air carriers, but we are splitting them out and keeping them in the commuter model. This model is the short-haul demand for air transportation. That is a commuter market, no matter what you call the commuter, operating small, under 60-passenger aircraft.

We are doing things like that. We have not spent as much effort on air carriers as on general aviation in the last few years. That is because GA produces a heavy workload for the FAA system, and will continue to do so. We have ten million air carrier operations at FAA towers, going up to 12 or 12.5 million, compared to general aviation operations of 50 million, going up to 100 million. That is where the emphasis has to be placed for our limited resources.

William Tucker, Air Transport, Canada

I agree with George Sarames, but one ingredient is missing. You must have a reason to do any forecast. The user determines what is to be produced. In Canada we do exactly what George Sarames advocates. We have a micromodel that starts from the bottom up, identifying O&D demand between nodes within Canada. Then we run that through a traffic flow model which identifies the services available. But we have quite a different need in Canada for the forecasts. The Canadian government owns and operates all the major airports. The Canadian government, therefore, plans the airports, plans the expansion of terminals and runways, builds new airports, whatever. So we have a microlevel need for data, a microlevel need for forecasts. Now, the Canadian market is a tenth or less of the American market. We have a complicated system for our markets. To apply that to the U.S. situation would be extremely difficult, or impractical. If anybody is interested in our approach, there are copies of our reports. Even better, come to our conference at the end of next month, and learn more about it.

David Raphael

Our whole purpose here is to help the FAA in any way that we can, so constructive advice is helpful. I believe that there are two or more approaches, and like triangulation in navigation, overdependence upon any one approach does not give the best results. Two or three approaches to forecasting general aviation and air carrier operations might be useful.