AVIATION FORECASTS. FISCAL YEARS 1976-1987

Federal Aviation Administration
Washington, D. C.

September 1975

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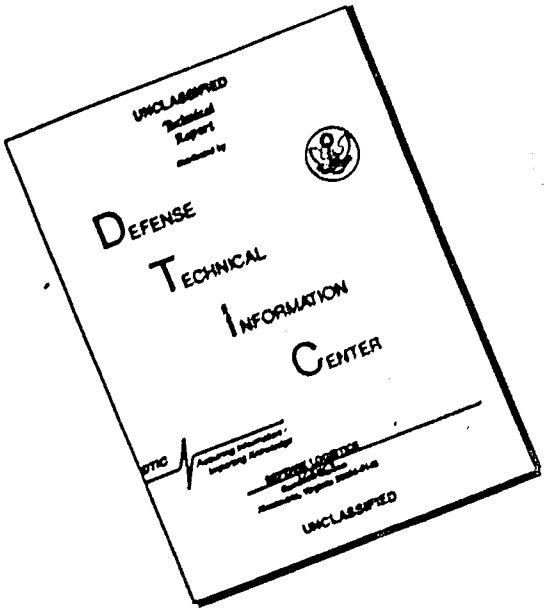

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AVIATION FORECASTS FISCAL YEARS 1976-1987

SEPTEMBER 1975

U.S. DEPARTMENT OF TRANSPORTATION

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16. Abstract

This report contains the latest Federal Aviation Administration forecast of measures of workload and activity at towered airports, air route traffic control centers, and flight service stations for Fiscal Years 1976 to 1987. The forecasts were made for the four major users of the system; air carriers, air taxi, general aviation and the military. The report has been prepared to meet the budget and planning needs of the various offices and services of FAA for data concerning future trends in aviation activity.

This report reflects the impact on aviation activity of a more rapid rate of price increase, especially for fuel, and a slower rate of real income growth than had been assumed in previous forecasts. Although this year's forecasts are lower than previous year's, aviation activity is forecast to increase by 41 percent at towered airports, 23 percent at air route traffic control centers and 54 percent in flight services performed by fiscal year 1980.

Of the users of the system, general aviation and air taxi will have the greatest percentage growth during the forecast years although in absolute terms the air taxi impact is relatively small. The air carriers will have a lower growth rate while military activity is expected to remain at its current levels throughout the forecast period. In absolute terms, general aviation will continue to increase its portion of all aviation activities so that by 1980 general aviation will account for 79 percent of total operations at towered airports, 27 percent of workload at air route traffic control centers and continue to increase its domination of flight services performed by the FAA.

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EXECUTIVE SUMMARY

This is the latest report in a series of forecasts of user demand for FAA services. The forecasts provide the support for agency budget requests and the basis for policy and plans development.

The basic underlying assumptions for the new forecasts include:

- An economic recovery within the next year and continued modest growth beyond.
- The supply of energy and fuel will not significantly inhibit economic or aviation growth, although prices are expected to increase throughout the forecast period.
- The basic trends in the air carrier industry and its service patterns which have evolved over the years will continue without substantial change.
- No economic or procedural changes will significantly inhibit the growth of general aviation.
- No operational constraints such as curfews are reflected.
- Military aviation activities were assumed to remain at or slightly below current levels.

The FAA provides the aviation community with three distinct operational services: air traffic control at selected airports; IFR en route traffic control; and flight services, including pilot briefings, flight plan filings, and aircraft contacts. These services are provided to four major categories of users: the air carriers, the air taxis, general aviation, and the military.

Each category uses these services in different degrees. Because of the different relationships and growth trends among the four users and the three FAA services, there is no one workload measure such as airport operations, or aviation activity series such as air carrier revenue passenger miles which typifies the past trends or future outlook for the whole of the FAA. There have been, and there will continue to be, different socio-economic and political forces which drive the growth trends in each major user category. Any analysis of the three basic FAA operational services should properly begin with a breakdown or separation by user category. All of the forecasts included herein follow this approach. First the underlying factors influencing the growth patterns of each major user are determined and forecast. Based on these trends and past relationships and through the use of econometric models, separate demand forecasts for FAA services are derived for each user category. The forecasts of total FAA operations and services reflect a summation of the individual forecasts of the four major users.

In summary, total aircraft operations (take-offs and landings) at airports with FAA air traffic control towers are forecast to increase by 41 percent between Fiscal Years (FY) 1975 and 1980 and to double the present level by FY 1987. This growth will be dominated by growth in general aviation flying. General aviation operations accounted for 75 percent of the total in FY 1975. By FY 1980 general aviation operations will be 79 percent of total operations. The FY 1987 estimate shows general aviation operations representing 82 percent of the total figure. By comparison, the air carrier portion of the FY 1975 total was 16 percent. By FY 1980 air carrier operations are expected to decline to 14 percent and by FY 1987 to 11 percent of total operations.

Total instrument operations at the same towered airports are forecast to show a growth pattern similar to aircraft operations, rising 35 percent by 1980 and 92 percent by 1987.

Expressed in terms of IFR aircraft handled the workload at the FAA air route traffic control centers is expected to increase 23 percent and 67 percent by FY 1980 and 1987, respectively. Air carrier traffic accounts for about

55 percent of the current volume followed by general aviation at 23 percent, military at 19 percent, and air taxis at 5 percent. Except for military traffic, all users are forecast to show relatively significant increases. The air carriers will increase 22 percent by FY 1980 and 52 percent by FY 1987. In the same time spans the number of general aviation IFR aircraft handled will rise 55 percent and 140 percent. General aviation aircraft handled will account for 34 percent of the total in FY 1987 compared with 23 percent today.

Flight services performed by the FAA, which include briefing pilots, filing flight plans, and contacting aircraft, are forecast to show the highest growth rate of any of the FAA operational series. By FY 1980 this volume is expected to show a 54 percent increase, and by FY 1987 the level should reach almost 2.5 times the current level. This series, as with aircraft operations, is dominated by general aviation use.

INTRODUCTION

This report contains the latest Federal Aviation Administration forecast of measures of workload and activity at towered airports, air route traffic control centers, and flight service stations for the period Fiscal Year (FY) 1976 to 1987. The forecasts were made for the four major users of the system; air carrier, air taxi, general aviation, and the military. The report has been prepared to meet the budget and planning needs of the various offices and services of FAA for data concerning future trends in aviation activity. It is one of a series of specialized aviation forecast studies issued annually by the FAA Aviation Forecast Branch, Office of Aviation Policy. The series includes "Military Air Traffic Forecasts 1976-1987", "Terminal Area Forecast 1976-1987", and "IFR Aircraft Handled Forecast by Air Route Traffic Control Centers 1976-1987". Copies of these reports are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

This year the report has been expanded to include three long-term forecasts. A baseline forecast for FY 1986 and FY 1987 is consistent with the short-term forecasts. In addition, a high and a low scenario, showing possible impacts of different economic conditions, are presented.

Table A is presented as a general overview of this year's forecasts. In addition to providing a capsule version of the September 1975 forecasts, Table A presents a comparison with last year's forecasts across the selected activity measures. Of the two sets of forecasts, the September 1975 forecasts are clearly more pessimistic. This reflects the impact on aviation activity of the more rapid rate of price increase, especially for fuel, and the slower rate of real income growth assumed for the September 1975 forecasts as

compared with the earlier forecast. It should be noted that this year's fiscal forecasts for 1977 and beyond are based on the new fiscal year period, October 1 through September 30.

Table A

FORECAST COMPARISONS

September 1975 versus September 1974

	Tower Operations (In millions)			Instrument Operations (In millions)		
	1975	1974	Percent Change	1975	1974	Percent Change
Actual 1975	59.0			26.2		
Forecast						
1976*	63.0	66.4	- 5.1	27.2	27.6	- 2.9
1977*	65.9	70.2	- 6.1	28.6	29.6	- 3.4
1978*	71.6	73.3	- 2.3	31.1	32.9	- 5.5
1979* **	77.8	76.2	+ 2.1	33.6	36.0	- 6.7
1986* (Baseline)	116.8	125.3	- 6.8	48.1	54.9	-12.4

	IFR Aircraft Handled (In millions)			Flight Services (In millions)		
	1975	1974	Percent Change	1975	1974	Percent Change
Actual 1975	23.6			58.3		
Forecast						
1976*	24.7	25.5	- 3.1	67.0	69.2	- 3.2
1977*	25.6	26.9	- 4.8	72.9	77.1	- 5.4
1978*	26.7	28.2	- 5.3	80.2	82.6	- 2.9
1979* **	33.1	36.0	- 8.1	85.8	89.7	- 4.3
1986* (Baseline)	36.5	40.4	- 9.7	132.9	164.8	-19.4

* Forecasts. Forecasts for fiscal years 1977 and beyond are presented for the new fiscal period (October 1 through September 30), the 1976 forecast is for the old fiscal period (July 1 through June 30).

**Three forecasts are included for 1986 based on differing economic assumptions. Forecasts shown here are for the baseline forecast.

Further detail on specific projections and their underlying assumptions are presented in the following text and in the Appendix. Additional information is available from the Aviation Forecasting Branch (AVP-120), Federal Aviation Administration, Washington, D. C. 20591, phone 202-426-3103.

HIGHLIGHTS OF FISCAL YEAR 1975

The aviation industry continued to be subject to a variety of economic and operational pressures which began during FY 1974. Rising fuel prices and other operating costs, and a depressed economy all had their constraining effect on aviation growth. The fuel problems which began in November 1973 continued to cause operational changes by air carriers and general aviation fliers.

Air Carriers

The effect of rising costs and a depressed economy were particularly pronounced on the air carrier industry. Air carrier aircraft operations for July through October 1974 reflected the effect of capacity reductions that were inaugurated during the oil embargo. With the advent of the new fall and winter schedules, airline operations began to show slight gains over the previous year when the oil embargo imposed reductions were at their height. However, air carrier operations for all of FY 1975 were approximately one percent less than during FY 1974 in the United States and its territories.

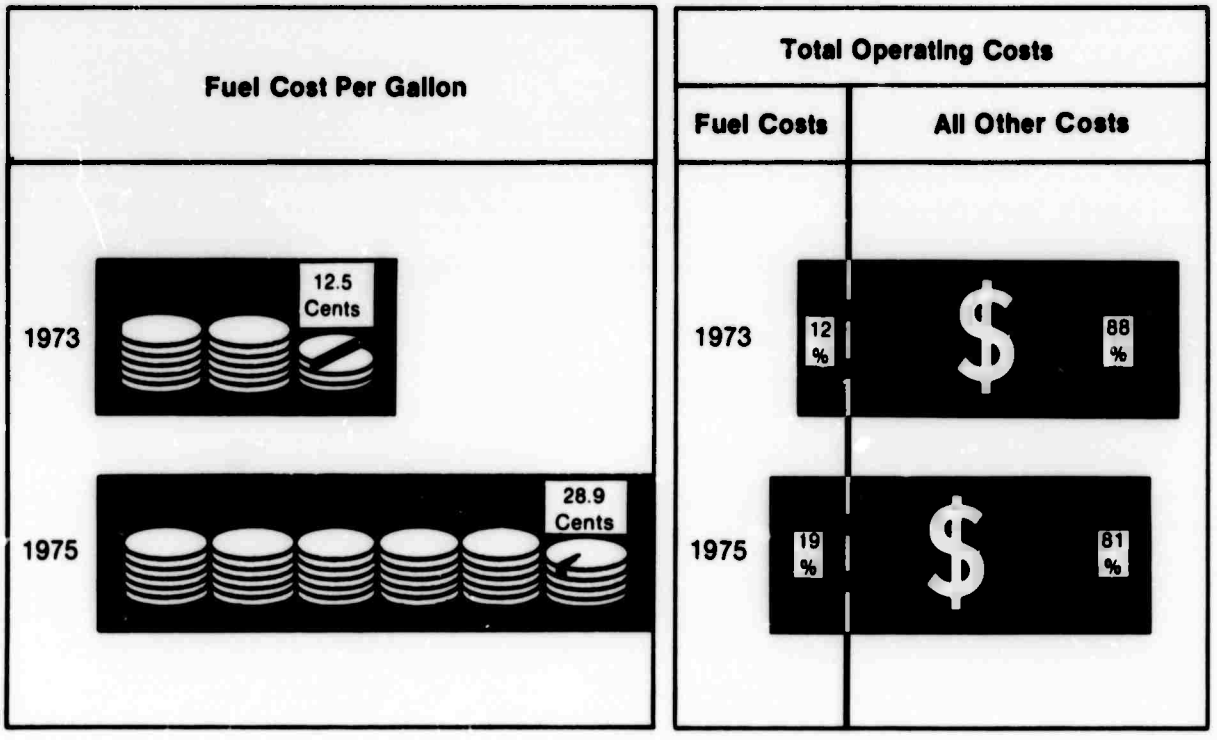
Although domestic air carrier operations decreased slightly during FY 1975 available seat-miles increased by 3 percent. This was brought about by the continued introduction of wide-body jets and larger standard-body jets while propeller and smaller jet aircraft were retired from the air carrier fleet. The United States international carriers during FY 1975 decreased their available seat-miles by 3 percent while decreasing their departures by 10 percent throughout the world.

Revenue passenger miles also decreased during FY 1975 due mainly to the depressed general economy. Domestic revenue passenger miles decreased by 1.7 percent while international revenue passenger miles decreased by 10.5 percent. This resulted in a domestic load factor of 52.7 percent

compared with 55.1 percent for FY 1974. The FY 1975 international load factor was 50.2 percent as compared with 54.2 percent in FY 1974.

Fuel prices continued to rise for the domestic and international air carriers during FY 1975. In June 1973 the average price of fuel was 12.5 cents per gallon for the total industry. By June 1974 this had increased to 24.9 cents per gallon. In June of 1975, the average industry price had increased to 28.9 cents. As a percent of total airline operating costs, fuel had risen from 12 percent in 1973 to approximately 19 percent in 1975. See Figure 1.

FIGURE 1
Air Carrier Fuel Expenses:
Cost Per Gallon and Percentage of Total Costs



Increases in fuel costs added to other operating cost increases along with a decrease in demand caused a decrease in income for the industry. During FY 1975 the domestic and international trunk carriers experienced a 14.1 percent increase in operating revenue per revenue ton-mile. However, a 4.9 percent decline in total revenue ton-miles resulted in an increase of only 8.4 percent in total operating revenue. During the same period total operating expense increased 12.7 percent causing a substantial decrease in net income when compared with FY 1974.

For FY 1975 the operating profit for the total air carrier industry was $281 million, a 63.8 percent drop from the $777 million profit reported for FY 1974. The international scheduled carriers continued to show a poor profit picture when looked at as a group. The international trunk carriers decreased from a FY 1974 operating profit of $11 million to an operating loss of $49 million in FY 1975.

General Aviation

The increase in total instrument operations between FY 1974 and FY 1975 was 8.7 percent; greater than the FY 1973 to FY 1974 increase of 6.7 percent. Part of this growth reflects the increased use of avionics by the GA fleet. Both GA and air taxi instrument operations increased over the 1974 to 1975 FY time frame while military and air carrier instrument operations did not change significantly from their FY 1974 level.

Total IFR aircraft handled by air route traffic control centers increased by 3.5 percent from 22.9 million in FY 1975. Air carrier IFR flying remained at its FY 1974 level, while air taxi, GA and military IFR aircraft handled increased by 18.2 percent, 7.8 percent, and 2.3 percent, respectively.

The total number of flight services provided by flight service stations and combined station/towers rose from 56.2 million in FY 1974 to 58.3 million in FY 1975, an increase of 3.7 percent. This series has exhibited an uninterrupted upward trend since its inception in 1962. The FY 1975 counts of pilot briefs, flight plans originated, and aircraft contacted were all higher than their FY 1974 levels.

The total number of active pilots was 730,541 as of January 1, 1975, up 2.2 percent from one year earlier. The most recent data shows that, with the exception of student and helicopter pilots, all types of pilot certifications increased over their levels for the preceding year.

The size of the active GA fleet increased from 153.5 thousand as of January 1, 1974 to 161.5 thousand one year later, up 5.2 percent. Similarly, hours flown by GA aircraft increased from 30.6 million in FY 1974 to 32.2 million in FY 1975, up 5.2 percent. However, both the increase in fleet size and the increase in hours flown are lower than their respective increases for the preceding year. The slowdown in the rate of increase reflects the effect of rapidly rising prices, especially in fuel cost, and a general slowing of activity in the national economy.

The impact of the economic situation is also reflected in GA aircraft production. Although GA aircraft production increased from 14,730 units in FY 1974 to 15,232 units in FY 1975 (up 3.4 percent), this increase is significantly lower than the 18 percent increase posted between FY 1973 and FY 1974.

Military

Military operations at FAA airport traffic control towers numbered 2.8 million in FY 1975 which was the same as FY 1974. Instrument operations also held nearly constant in FY 1975 at 4 million. Military aircraft handled at FAA air route traffic control centers showed a slight increase from 4.3 million in FY 1974 to 4.4 million in FY 1975.

FAA Operations

Total aircraft operations increased by 3.9 percent from 56.8 million in FY 1974 to 59.0 million in FY 1975. Part of this increase may be attributed to net gain of 22 towers during FY 1975. Over this time period, itinerant operations increased by 4.2 percent and local operations by 2.9 percent. These percentage increases are lower than those for the 1973 to 1974 fiscal

years. The slowdown in the rate of growth of operations may be attributed to the impact of the general economy on aviation. The increase in itinerant operations was due to the growth in GA and air taxi operations since air carrier itinerant operations decreased and military itinerant operations remained at about their FY 1974 level. Similarly, the growth in local operations was due to an increase in GA operations since local operations for the military declined from the preceding year.

AVIATION FORECAST HIGHLIGHTS

Air Carrier

Due to an expected economic recovery beginning in late 1975, scheduled passenger traffic is forecasted to increase substantially in Fiscal Year (FY) 1976. Most of this growth, however, is expected in scheduled domestic traffic since growth is not anticipated in the North Atlantic and other foreign markets for U. S. carriers. After this FY 1976 recovery period, total industry revenue passenger enplanements (ENP) will increase at a 5.8 percent annual rate through FY 1982, while the revenue passenger mile (RPM) average annual growth rate is forecasted at 6.3 percent. The international markets will strengthen during this FY 1977 to FY 1982 period and experience RPM annual growth of 6.1 percent and an ENP rate of 5.5 percent. In the meantime, domestic growth is expected to decelerate to a 6.0 percent annual growth rate in ENP and a 6.4 percent rate in RPM.

General Aviation

Just as passenger traffic can be used as an important measure of air carrier activity, the general aviation fleet size and hours flown are important indicators of general aviation activity. For example, the annual growth rate in the active GA fleet of 3.3 percent emphasizes an increasing popularity of general aviation flying. Moreover, the 5.0 percent per year increase in GA hours flown reflects a greater utilization of each active aircraft. Interestingly, the largest growth occurs in the multi-engine and turbine classes of aircraft. This points to an increased sophistication among the GA pilots.

Military

The FY 1980 military aircraft forecast shows 19,935 active aircraft and 6,555,000 flying hours -- an average of 329 hours per aircraft. This is a slight decrease from the FY 1975 fleet of 20,203 aircraft and 6,652,000 flying hours. The average utilization for the FY 1975 fleet was 333 hours per aircraft.

Because of the nearly constant level of military flying throughout the forecast period the FAA workload attributable to this flying is forecast to remain relatively constant at FAA control towers, traffic control centers and flight service stations

Fleet and Hours Flown

A comparison of the changing ratios in size of active fleets and hours flown by the air carriers, GA and military is shown in Figure 2. These changing ratios emphasize the change in relative magnitude of demand each category is expected to place on the air system. The GA portion of the total fleet will grow to 90 percent by 1982. On the other hand, because of the high utilization rates of the air carrier aircraft, the air carrier hours will remain a significant factor in the total hours.

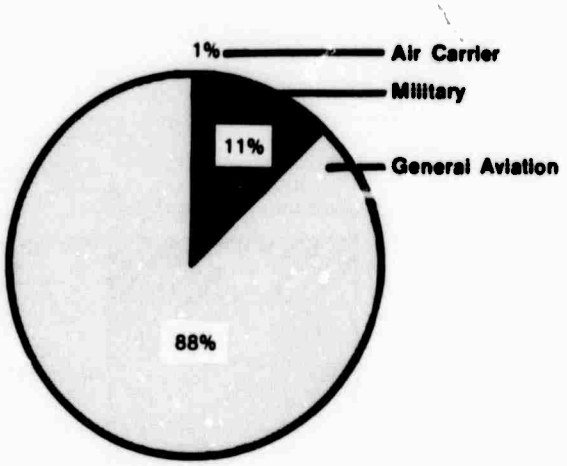
FAA Workload

Although fleet size and hours flown are important measures of future aviation activity, activity at FAA terminal, en route, and flight service station facilities are the relevant forecasts for FAA manpower and facility planning. Total operations at FAA air traffic control towers, instrument operations, en route aircraft handled, and total flight services comprise the important workload measures.

Currently, twelve additional towers are scheduled for commissioning in FY 1976. These additional towers in FY 1976 combined with the expected economic recovery are forecasted to cause a 6.8 percent increase in tower operations over the corresponding 1975 total. The average yearly growth rate is forecasted to be 7.0 percent through FY 1982. See Figure 3. As shown in Figure 4, the early growth occurs mainly in itinerant operations, while the later growth results mostly from increases in local operations. The growth in itinerant operations can be attributed primarily to relatively high growth rates in air taxi and general aviation activity plus some increase in air carrier operations. The increase in local operations are brought about solely by general aviation since military operations are expected to remain

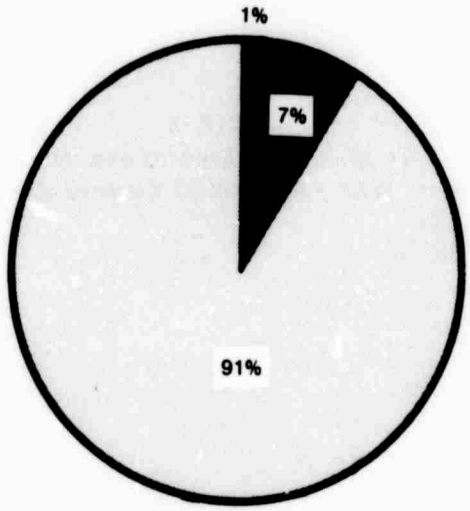
FIGURE 2
Comparison of Active Aircraft Fleet to Hours Flown

FLEET



1975

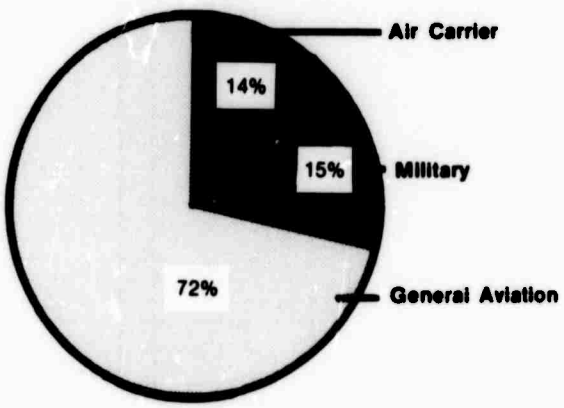
184,025 Active Aircraft



1987

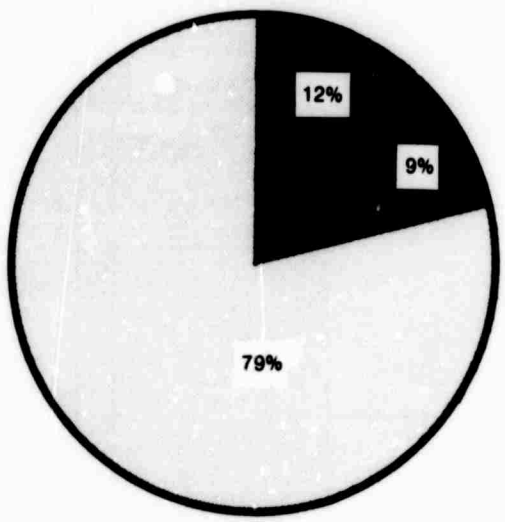
279,844 Active Aircraft

HOURS



1975

45,020,000 Hours Flown

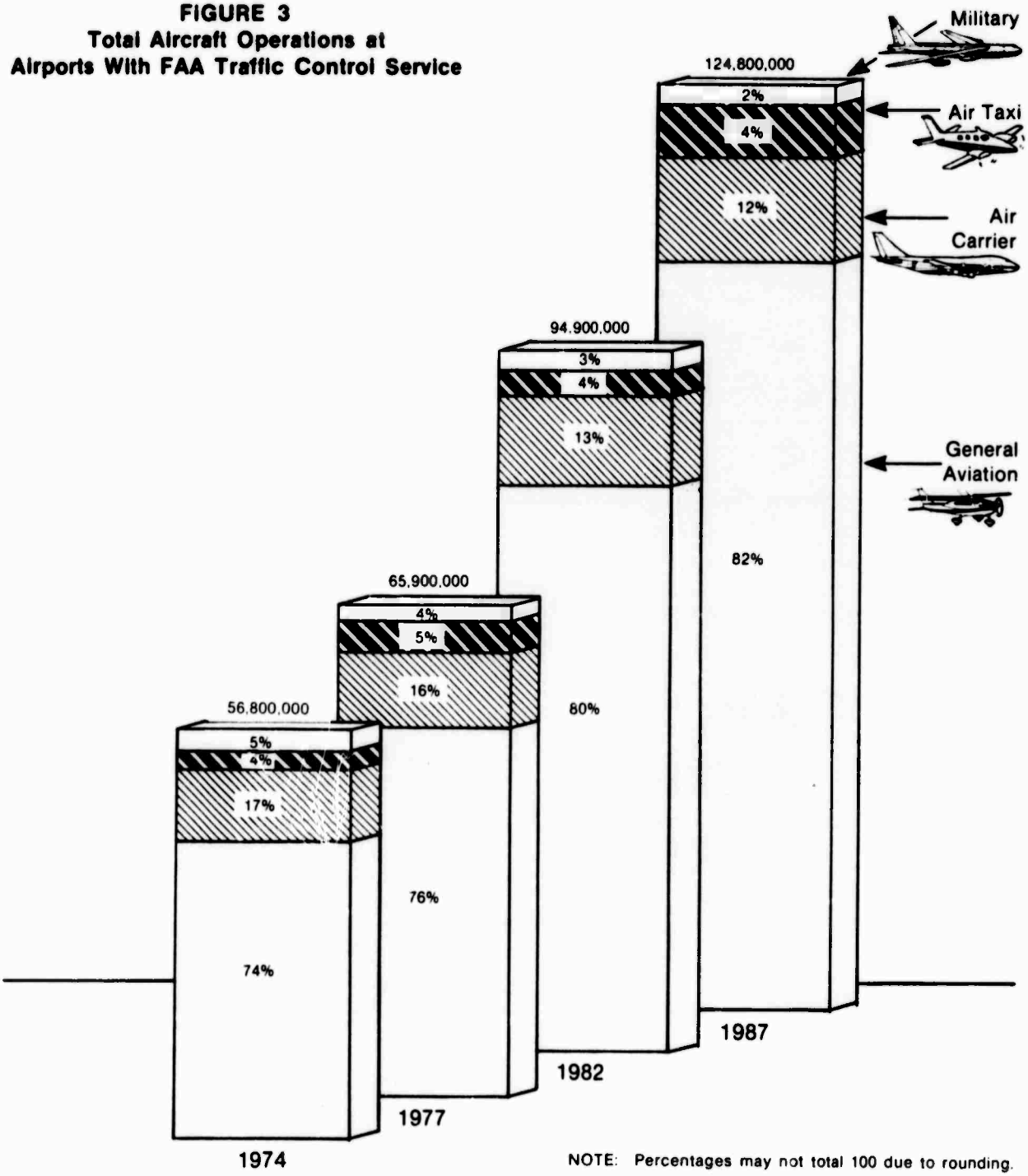


1987

76,450,000 Hours Flown

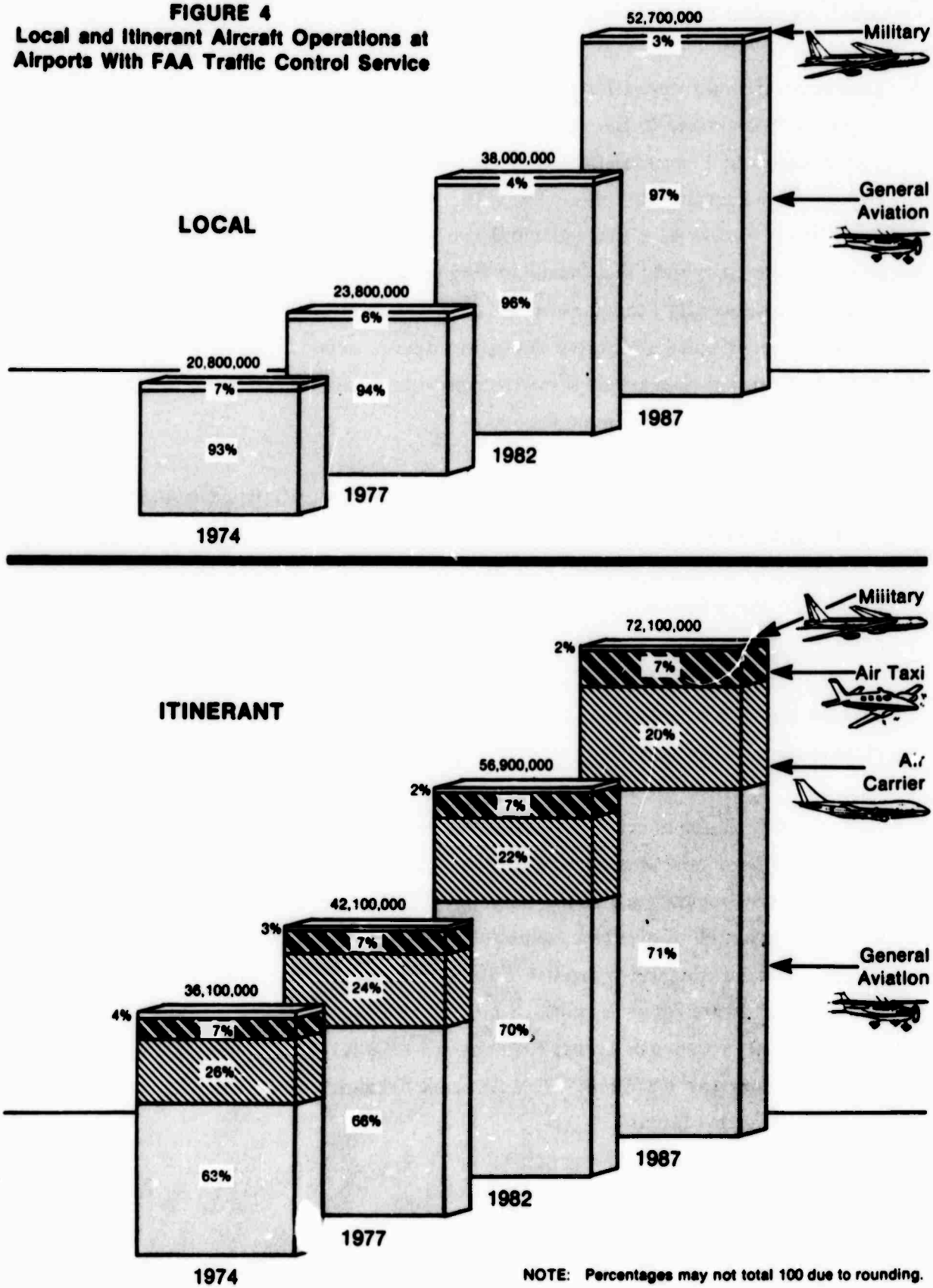
NOTE: Percentages may not total 100 due to rounding.

FIGURE 3
Total Aircraft Operations at
Airports With FAA Traffic Control Service



NOTE: Percentages may not total 100 due to rounding.

FIGURE 4
Local and Itinerant Aircraft Operations at Airports With FAA Traffic Control Service



NOTE: Percentages may not total 100 due to rounding.

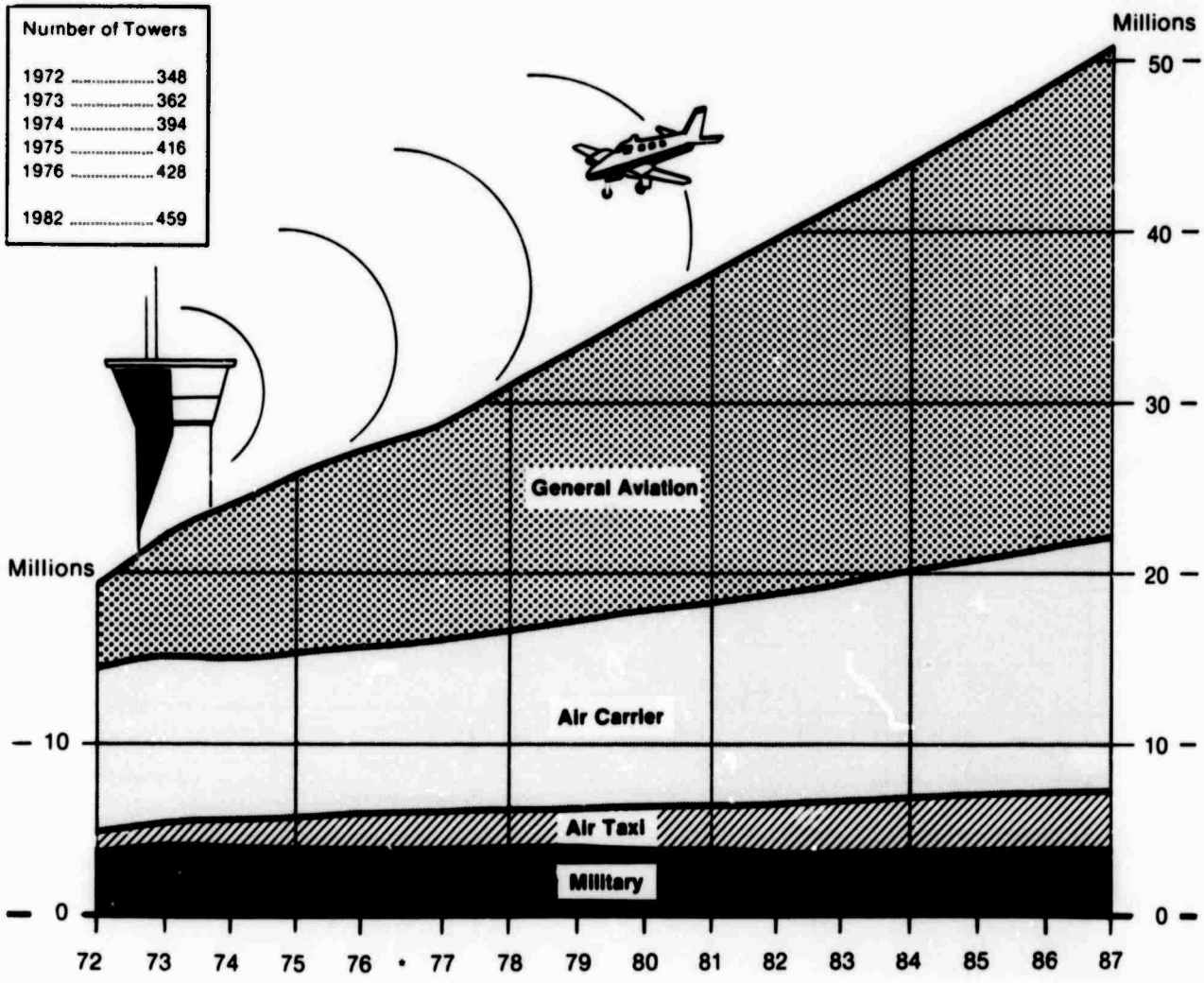
nearly eonstant throughout the foreeast period.

Like total aircraft operations, instrument operations at FAA towers are expected to inerease in the years ahead. However, beeause further implementation of Terminal Control Areas and Stage III of expanded radar serviee is not antieipated after FY 1976, this will cause instrument operations to grow at a more normal rate. General aviation is expeeted to eontinue past trends and inerease its use of sophistieated avionics equipment. Consequently, the general aviation eategory of instrument operations will grow at an average 8.5 pereent annual rate through FY 1987. Total instrument operations are forecast to increase at a 5.7 pereent annual growth rate. See Figure 5.

The reasons for the forecasted increase in aetivity at air route traffic control eenters are similar to those for instrument operations. In the future, general aviation aetivity will have an increasing impaet on eenter workload. As an example, general aviation IFR aireraft handled are expeeted to grow at a 7.5 percent rate per year through FY 1982. Complementing this growth is an expected 4.0 pereent annual growth rate in air carrier aircraft handled and no growth in military activity. Figure 6 depicts the growth of aetivity at eenters by user category.

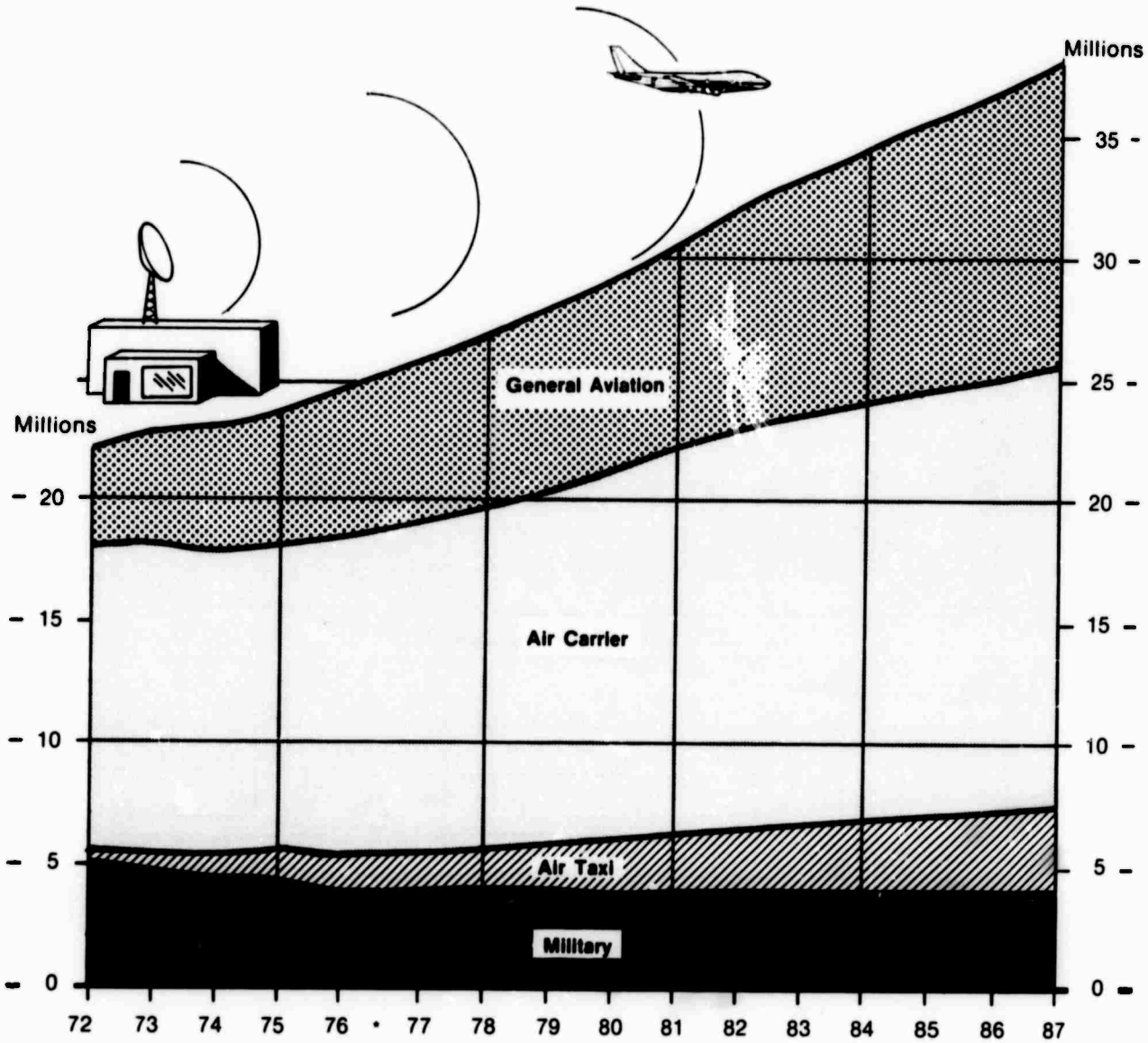
Historically, flight serviee stations have provided the greatest share of their flight serviees to general aviation. The basie workload measure for the flight serviee stations is the number of flight serviees which is a weighted measure of aireraft eontaeted, flight plans originated, and pilot briefs. During the period from FY 1975 to FY 1982 total flight serviees are forecast to inerease from 58.3 million to 104.4 million. By FY 1987 total flight services are foreeast to reaeh 143.6 million, a nearly 150 pereent increase over FY 1975. The forecast breakdown of total flight serviees is shown in Figure 7.

FIGURE 5
Instrument Operations at
Airports With FAA Traffic Control Service



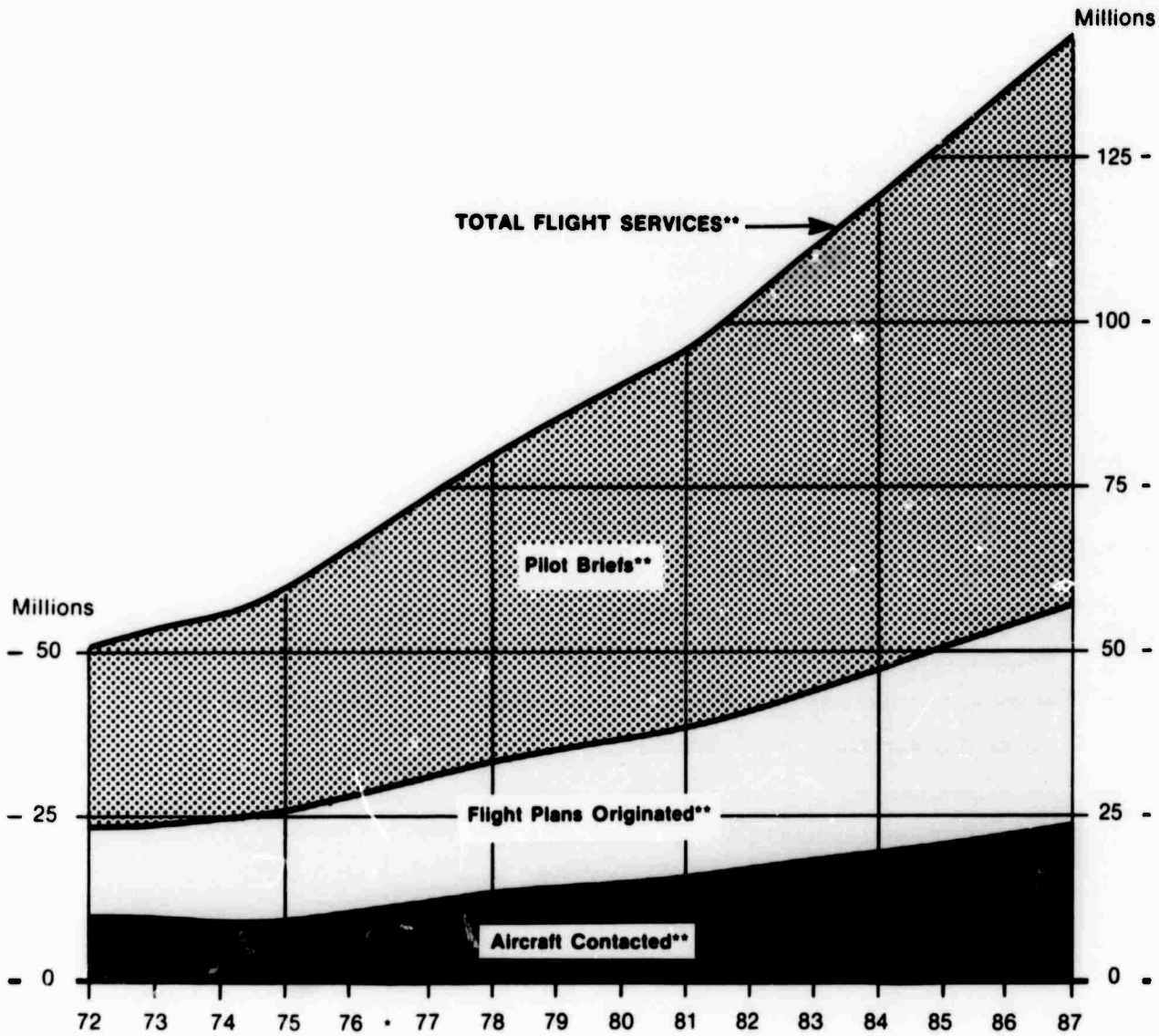
Fiscal Years (* indicates transitional quarter)

FIGURE 6
IFR Aircraft Handled by
FAA Air Route Traffic Control Centers



Fiscal Years (* indicates transitional quarter)

FIGURE 7
Total Flight Services at
FAA Flight Service Stations and Combined Station/Towers



Fiscal Years (* indicates transitional quarter)

** Total Flight Services is a weighted workload measurement derived by multiplying pilot briefs and flight plans originated by two and adding the number of aircraft contacted. This graph depicts the components in their weighted form.

Air Carrier Demand Forecasts

Air carrier operations form one major segment of the workload borne by FAA facilities. Since future changes in demand for air transportation affect air carrier planning, forecasts of revenue passenger miles (RPM) and enplanements (ENP) as measures of that demand are needed to forecast air carrier activity. Decreases in demand for air transportation over the past year suggest that RPM's and ENP's are sensitive to both income and price variables. Declining real income and increased fares have combined to reduce demand from FY 1974 levels. This phenomenon coupled with a forecast of a sluggish economic recovery and continued increases in fares has led to forecasts of air carrier demand lower than those prepared in the past.

Methodology. The forecasts depend on the assumption that demand for air carrier services depends upon the economy. The exact relationships between various measures of economic activity and air carrier demand were econometrically estimated based on historical data. The variables determining RPM and ENP were then forecasted, and demand forecasts were generated based on the estimated historical relationships. The economic variables used include:

- Personal consumption of services
- Number of civilians employed
- Air transport investment
- Automobile purchases
- Cost of automotive transportation
- Air fares

Personal consumption of services is used to represent the impact of income. The number of civilians employed reflects the impact of population

growth on demand. Investment in plant and equipment by the air transport industry is a surrogate for level of service. The purchase of automobiles represents competition from other modes, while the relationship between air fares and the costs of private transportation represent price competition from other modes. Generally, the model shows that as air fares and auto purchases increase, demand falls, and that as income, population, and investment increase, demand rises. See Figure 8.

Assumptions. The forecasts generated by the model assume that the historical relationships among these variables will continue into the future. The assumptions about the economy are summarized below.

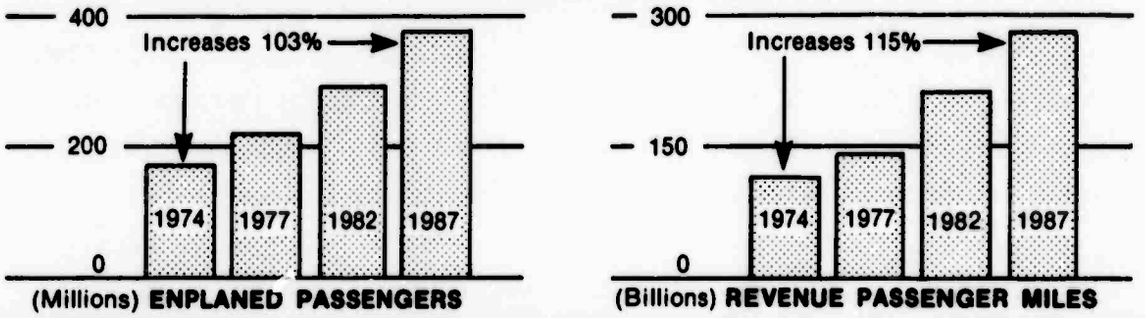
- Air fares will increase, reflecting increasing airline operating costs. However, the cost of private transportation is expected to increase more rapidly than air fares because fuel costs are a major portion of the cost of automobile transportation.
- Despite economic recovery beginning in late 1975, the consumption of services will lag as consumers concentrate on durable purchases. Consistent with this assumption new automobile purchases will increase in the near term and then decline as fuel prices constrain vehicle use.
- Employment as a percent of the total population will remain relatively stable through the forecast period.
- Investment in air transport will continue at current levels, increasing to an average growth rate of 9.5 percent per year by 1986.
- Fuel costs will continue to increase but there will be no restrictions on the amount available for use.

For a more detailed discussion of the model and assumptions, see Appendix A.

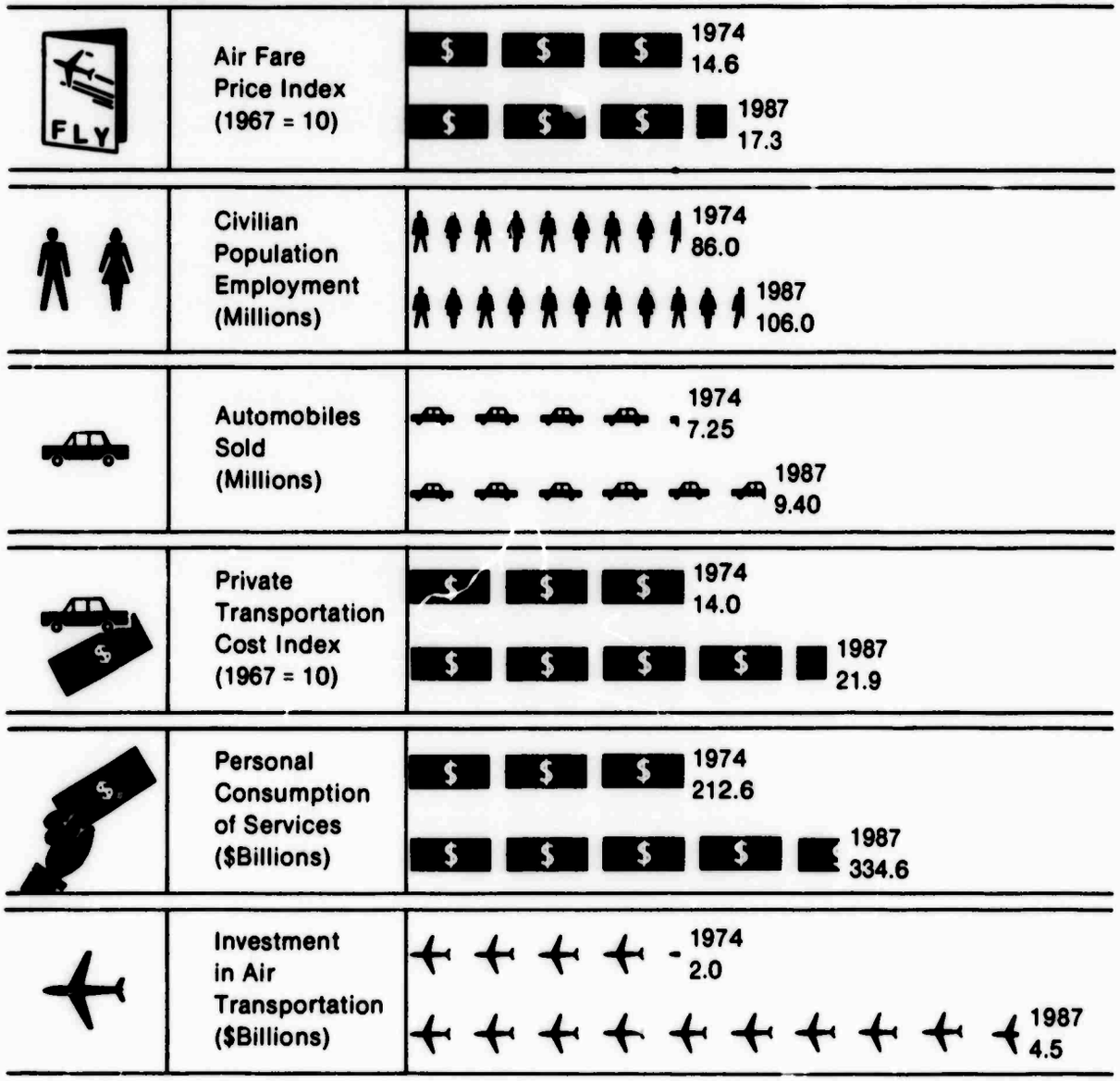
Air Carrier Activity Forecasts

The sanctioning of capacity agreements by the CAB impacted on air carrier operations during FY 1975. This policy plus the slow economic recovery and accelerating fuel costs resulted in a slight decrease in air carrier activity when compared to FY 1974 levels.

FIGURE 8
Scheduled Domestic Passenger Traffic and Forecast Variables



FORECAST VARIABLES



With the removal of capacity agreements, the airlines are expected to increase frequencies. The resulting increase in operations will be strengthened further by the economic recovery. On the other hand, higher fares will dampen these increases. The net result of these offsetting factors is a delay of one year in the growth of air carrier operations when compared with the 1974 FAA forecast.

The forecast of the level of air carrier traffic activity and workload at FAA facilities for the period fiscal years 1976-1982 and for long-term planning (fiscal years 1986-1987) involved several steps. After developing a forecast for the expected level of revenue passenger miles and enplanements, forecasts of the air carrier fleet and the resulting operations were made. The factors that influenced these forecasts and the two methods used are explained below.

Methodology -- First Method

The first method began with a summarization of individual forecasts prepared for each air carrier. The base for these forecasts was the number of aircraft, by type, each carrier has on hand and on order. The estimates for future types and numbers of aircraft were made after discussions with many of the air carriers and all the major U. S. aircraft manufacturers. Additional aircraft orders beyond those announced publicly were estimated in order to provide the increased capacity needed to carry anticipated traffic growth; to provide for retirement of aircraft; and for individual airlines to maintain a competitive position with other airlines. Judgement, influenced by the discussions held with knowledgeable people within the industry, was used to project the individual carrier fleets by aircraft types beyond the years for which aircraft order information was available. Service patterns and frequencies of service were also forecast in general terms after discussions with members of the industry.

Assumptions

Aircraft

2 engine

- Continued introduction of DC-9 and 737 (both new and purchased from trunk carriers) into local service carrier fleets
- Stretch versions of present 2 engine aircraft will replace remaining turboprops in late 1970's

3 engine

- Continued introduction of wide-body aircraft and 727-200
- Introduction of new aircraft in late 1970's with seating capacity between 727-200 and wide-body aircraft
- Stretch versions of present wide-bodies will appear in early 1980's

4 engine

- Retirement of non fan and some older fan-jet aircraft will occur before FAR-36 rules become effective

Seating Capacity

- Continued decrease in size of first class section with resulting increase in size of coach section
- Number of seats abreast will increase by one in wide-body jets in late 1970's

Load Factor

- Will increase from present 53% to 57% by the early 1980's

Methodology -- Second Method

The second method used was a model developed to forecast air carrier operations. The model forecasts for the total industry rather than by carrier. The model is based on linear equations developed from historical data and the interrelationship between various factors in air carrier operations. The results of this forecasting model were substantially the same as those determined by the first method.

The air carrier operations forecast depends upon

- Revenue passenger miles
- Average load factor
- Average seating capacity
- Average stage length

These variables are forecasted based on time series analysis with adjustments for the effects of cost and fare changes. When costs increase faster than fares, for example, airline profitability requires an increase in load factor. Similarly, changes in aircraft size are reflected in the average seating capacity.

Assumptions. In general, the economic conditions assumed are the same as those used in the air carrier demand model. The following assumptions were also made. See Figure 9.

- Load factor will increase gradually from 53 percent to about 57 percent by the early 1980's
- The average seating capacity will follow historical trends and increase by about 4 seats per year. Implicit here is less use of wide-bodied aircraft than had been assumed earlier in forecasts

The average stage length will increase by about three miles per year

General Aviation Activity Forecasts

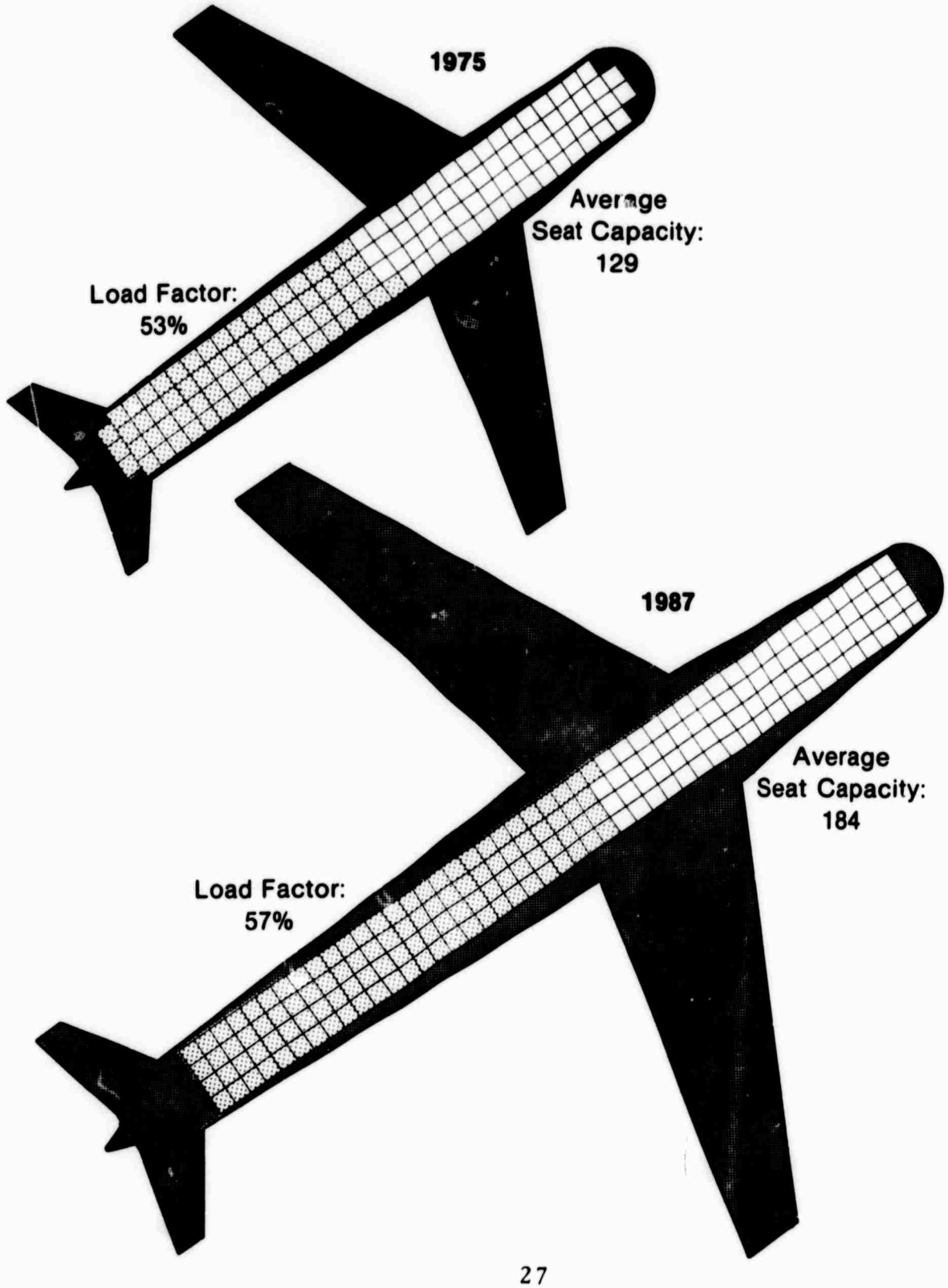
General aviation (GA) activity is expected to increase faster than total aviation activity, placing additional workloads on FAA facilities and manpower. However, the actual FY 1975 levels of activity did not reach those expected in the 1974 forecasts. This may be attributed to the fact that the FY 1974 forecasts underestimated the magnitude and impact of fuel cost increases and the length of the economic downturn. The greatest impact occurred in local tower operations, which consist primarily of student and practice flying and are highly sensitive to cost changes.

The exception to the above generalizations was FY 1975 GA itinerant operations, which were only slightly below their 1974 forecasted levels. Interestingly, VFR flight plans are below last year's estimates. Aside from economic conditions, the slow rate of growth in VFR flight plans may be attributed to increased use of sophisticated electronic navigation equipment in GA aircraft. Because of this factor, the FAA has recently proposed the elimination of VFR flight plan filing for most flights. Implementation of this proposal would virtually eliminate VFR flight plan activity.

Methodology. Most of the forecasts of general aviation activity were derived from a simultaneous equation econometric model relating measures of activity to economic and demographic variables. The number of civilians employed, expenditures on plant and equipment by the aircraft industry, factory sales of automobiles, and real per capita disposable income were the important exogenous variables. For further explanation of the rationale for using these variables, and for a discussion of results of the model, see Appendix B.

Activity measures not forecasted by this model were generated from a time series analysis. Variables such as average hours flown per operation and

FIGURE 9
Average Air Carrier Seating Capacity and Load Factor



average fuel consumption per hour were forecasted based on historical trends. These ratios were then applied to the operations forecast.

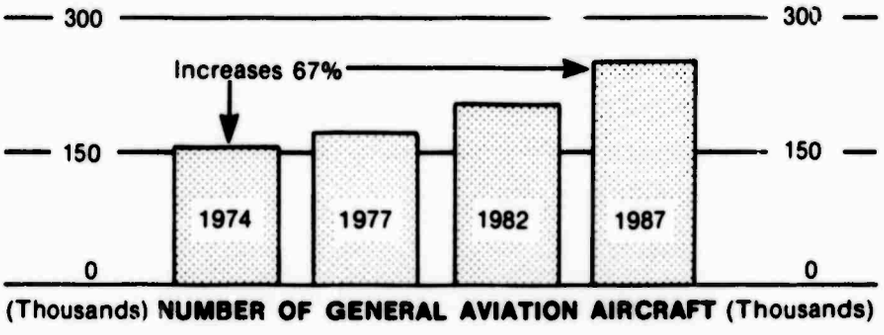
Assumptions. The general aviation activity forecasts are based on economic assumptions consistent with the air carrier RPM and activity forecasts. See Figure 10. In addition to those mentioned, some additional assumptions include:

- No further expansion in terminal control areas or Stage III of expanded radar service is expected beyond 1975 levels.
- Real per capita disposable income is assumed to grow at 3 percent per year throughout the forecast period.
- Investment in new plant and equipment by the aircraft manufacturing industry will grow to $4.0 billion per year by 1987.

Military Activity Forecasts

All military operational activity forecasts are based on information provided by the Department of Defense. Military operations are forecast to hold nearly constant throughout the forecast period.

FIGURE 10
General Aviation Aircraft Fleet and Forecast Variables



FORECAST VARIABLES

	Civilian Population Employment (Millions)	1974 86.0 1987 106.0
	Automobiles Sold (Millions)	1974 7.25 1987 9.40
	Investment in Aircraft Production ($Billions)	1974 0.8 1987 4.0

AVIATION INDUSTRY FORECASTS

Fiscal Years 1976-1982

Tables 1 through 4 present forecasts of traffic, fleet size, and the miles and hours that will be flown by the air carrier fleet. Tables 5 through 7 are forecasts of the general aviation fleet size and its use. Table 8 is a forecast of fuel consumption for the air carriers and general aviation. Tables 9 and 10 portray the outlook for civil aircraft and engine production. Tables 11 through 17 display forecasts of the different measures of air traffic activity and workload at FAA terminal, en route, and flight service station facilities. The data in Table 18 is a forecast of the number of active pilots by type of certificate.

Table 1

UNITED STATES CERTIFICATED ROUTE AIR CARRIER

SCHEDULED PASSENGER TRAFFIC

Fiscal Year	Revenue Passenger Enplanements (millions)			Revenue Passenger-Miles (billions)		
	Total	Domestic	International	Total	Domestic	International
1971	170.0	153.0	17.0	132.3	104.2	28.1
1972	182.9	164.5	18.4	144.2	112.3	32.0
1973	197.3	178.4	19.0	157.9	122.6	35.4
1974	208.1	189.5	18.6	165.0	130.0	35.0
1975	201.9	184.9	17.0	159.0	127.7	31.3
1976*	217.1	200.1	17.0	170.5	139.3	31.2
1977T*	57.2	52.8	4.4	45.4	36.9	8.5
1977*	233.0	214.9	18.1	184.9	150.4	34.5
1978*	248.1	228.8	19.3	197.7	160.7	37.0
1979*	261.6	240.9	20.7	210.2	170.1	40.1
1980*	273.6	252.3	21.3	220.4	178.8	41.6
1981*	290.3	268.0	22.3	234.7	190.8	43.9
1982*	310.1	286.6	23.5	251.5	205.0	46.5

* Forecast

1977T* -- This represents activity during the transition quarter, July 1, 1976 to September 30, 1976.

Table 2

TOTAL AIRCRAFT IN THE SERVICE OF UNITED STATES AIR CARRIERS

(As of January 1)

Aircraft Type	Reported 1975	Forecast 1976	1977	1978	1979	1980	1981	1982
Total Aircraft	2,526	2,609	2,687	2,762	2,838	2,907	2,975	3,095
Fixed-wing Aircraft	2,516	2,599	2,675	2,749	2,824	2,892	2,959	3,078
Jet	2,094	2,171	2,260	2,361	2,470	2,569	2,656	2,794
2-engine	541	570	606	646	682	720	732	744
3-engine	926	976	1,032	1,096	1,171	1,234	1,349	1,463
4-engine	627	625	622	619	617	615	575	587
Turboprop	296	302	299	290	276	263	255	247
1-and 2-engine	223	225	227	223	218	213	207	201
4-engine	73	77	72	67	58	50	48	46
Piston	126	126	116	98	78	60	48	37
1-and 2-engine	84	84	78	69	56	45	41	37
4-engine	42	42	38	29	22	15	7	--
Helicopter	10	10	12	13	14	15	16	17

Note -- Included here are all passenger and cargo aircraft owned or leased by and in the domestic or international service of the United States certificated route, supplemental, intrastate, and commercial air carriers. Aircraft used for training and aircraft that have been withdrawn from service and are awaiting disposal are not included here. Aircraft in the service of air taxi operators are shown in the general aviation aircraft fleet on another page of this report.

Table 3

TOTAL AIRBORNE HOURS, UNITED STATES AIR CARRIERS

By Fiscal Year (millions)

Aircraft Type	Reported 1975	Forecast 1976	1977T	1977	1978	1979	1980	1981	1982
Total Aircraft	6.17	6.42	1.69	6.39	6.91	7.14	7.40	7.66	7.93
Fixed-wing Aircraft	6.16	6.41	1.69	6.68	6.90	7.13	7.38	7.64	7.91
Jet	5.62	5.85	1.54	6.14	6.41	6.67	6.97	7.23	7.52
2-engine	1.40	1.52	.41	1.63	1.69	1.77	1.86	1.90	1.93
3-engine	2.56	2.67	.72	2.86	3.08	3.27	3.48	3.81	4.03
4-engine	1.66	1.66	.41	1.65	1.64	1.63	1.63	1.52	1.56
Turboprop	.44	.46	.12	.45	.42	.40	.37	.37	.36
1-and 2-engine	.33	.34	.09	.34	.33	.32	.31	.31	.30
4-engine	.11	.12	.03	.11	.09	.08	.06	.06	.06
Piston	.10	.10	.03	.09	.07	.06	.04	.04	.03
1-and 2-engine	.07	.07	.02	.06	.05	.04	.03	.03	.03
4-engine	.03	.03	.01	.03	.02	.02	.01	.01	--
Helicopter	.01	.01	.00	.01	.01	.01	.02	.02	.02

Note -- Included here are hours flown by all passenger and cargo aircraft that are owned or leased by and are in the domestic or international service of the United States certificated route, supplemental, intrastate, and contract air carriers. 1977T includes July 1, 1976 through September 30, 1976.

Table 4

TOTAL STATUTE MILES, UNITED STATES AIR CARRIERS

By Fiscal Year (millions)

Aircraft Type	Reported 1975	Forecast 1976	1977T	1977	1978	1979	1980	1981	1982
Total Aircraft	2,497	2,596	672	2,688	2,787	2,884	2,988	3,098	3,223
Fixed-wing Aircraft	2,496	2,595	672	2,687	2,786	2,883	2,987	3,097	3,222
Jet	2,376	2,472	642	2,568	2,677	2,779	2,893	3,003	3,132
2-engine	495	532	140	559	580	603	638	651	662
3-engine	1,097	1,157	308	1,232	1,324	1,406	1,485	1,638	1,737
4-engine	784	783	194	777	773	770	770	714	733
Turboprop	99	102	25	100	95	91	86	86	84
1- and 2-engine	75	76	19	76	75	73	70	70	68
4-engine	24	26	6	24	20	18	16	16	16
Piston	21	21	5	19	14	13	8	8	6
1- and 2-engine	13	13	3	11	9	8	6	6	6
4-engine	8	8	2	8	5	5	2	2	--
Helicopter	1	1	0	1	1	1	1	1	1

Note -- Included here are miles flown by all passenger and cargo aircraft owned or leased by and in the domestic or international service of the United States certificated route, supplemental, intrastate, and contract air carriers. Miles for fiscal year 1975 are partially estimated. 1977T includes July 1, 1976 through September 30, 1976.

Table 5

ESTIMATED ACTIVE GENERAL AVIATION AIRCRAFT BY TYPE OF AIRCRAFT

(In thousands)

As of January 1	Total	Fixed Wing			Rotorcraft	Balloons Dirigibles Gliders
		Piston		Turbine		
		Single-engine	Multi-engine			
1971	131.7	109.5	16.0	2.4	2.3	1.6
1972	131.1	109.1	15.5	2.5	2.4	1.7
1973	145.0	120.4	17.3	2.6	2.8	1.9
1974	153.5	126.1	18.7	3.3	3.1	2.3
1975	161.5	131.7	20.1	4.0	3.3	2.4
1976*	167.0	135.3	21.2	4.5	3.4	2.6
1977*	172.2	138.8	22.4	4.8	3.5	2.7
1978*	178.0	143.1	23.2	5.3	3.6	2.8
1979*	184.0	147.3	24.3	5.7	3.8	2.9
1980*	189.0	150.4	25.4	6.4	3.9	2.9
1981*	195.0	154.6	26.6	6.8	4.0	3.0
1982*	202.0	160.2	27.6	7.0	4.1	3.1

* Forecast

Note -- As of January 1, 1971, the definition used for determining the active general aviation fleet was changed. Formerly an active aircraft was one certificated as eligible to fly. Now an active aircraft must have a current registration and have been flown during the previous calendar year. It should be noted that historical data are estimates.

Table 6

ESTIMATED ACTIVE GENERAL AVIATION AIRCRAFT BY FAA REGION

(In thousands)

As of January 1	Total	FAA Region										
		ANE	AEA	ASO	AGL	ACE	ASW	ARM	AWE	ANW	AAL	APC
1971	131.7	4.7	17.0	18.5	25.9	10.1	18.1	7.0	20.4	7.0	2.5	.2
1972	131.1	4.7	16.9	18.5	25.9	9.8	17.8	6.8	20.4	7.1	2.6	.3
1973	145.0	5.3	18.6	21.1	28.1	10.6	19.5	7.6	22.8	7.9	3.0	.3
1974	153.5	5.5	19.8	23.2	29.1	11.1	20.7	7.9	24.0	8.3	3.3	.3
1975	161.5	6.2	21.2	24.4	30.7	11.6	21.7	8.3	25.1	8.6	3.4	.3
1976*	167.0	6.4	21.9	25.3	31.7	11.9	22.4	8.6	25.9	8.9	3.6	.4
1977*	172.0	6.6	22.6	26.1	32.7	12.3	23.1	8.9	26.6	9.1	3.6	.4
1978*	178.0	6.9	23.4	26.0	33.8	12.7	23.9	9.2	27.6	9.5	3.7	.4
1979*	184.0	7.1	24.1	27.9	34.9	13.1	24.7	9.5	28.6	9.8	3.9	.4
1980*	189.0	7.3	24.8	28.6	35.9	13.5	25.4	9.7	29.3	10.0	4.1	.4
1981*	195.0	7.5	25.8	29.5	37.1	13.9	26.2	10.0	30.3	10.4	4.1	.5
1982*	202.0	7.7	26.5	30.6	38.4	14.5	27.1	10.4	31.4	10.7	4.2	.5

* Forecast.

Note -- Totals include a small number of aircraft located in foreign countries. Also see Table 5 footnotes.

Table 7

ESTIMATED HOURS FLOWN IN GENERAL AVIATION BY TYPE OF AIRCRAFT

(In millions)

Fiscal Year	Total	Fixed Wing			Rotorcraft	Balloons Dirigibles Gliders
		Piston		Turbine		
		Single-engine	Multi-engine			
1971	25.8	19.0	4.2	1.4	0.9	0.2
1972	26.4	19.4	4.3	1.5	1.0	0.2
1973	28.5	20.8	4.7	1.7	1.1	0.2
1974	30.6	22.3	5.0	2.0	1.1	0.2
1975 1/	32.2	23.3	5.3	2.2	1.2	0.2
1976*	33.6	24.3	5.5	2.4	1.2	0.2
1977T*	8.7	6.2	1.4	.7	.3	.1
1977*	34.6	24.8	5.7	2.6	1.3	0.2
1978*	37.0	26.5	6.1	2.9	1.3	0.2
1979*	39.0	27.8	6.5	3.1	1.4	0.2
1980*	41.5	29.5	6.9	3.4	1.5	0.2
1981*	43.5	30.7	7.3	3.7	1.6	0.2
1982*	45.3	31.9	7.6	3.9	1.7	0.2

* Forecast. 1/ Preliminary.

Note -- Detail may not add to total due to independent rounding. It should be noted that historical data are estimates.

1977T* represents the transition quarter, July 1, 1976 through September 30, 1976.

Table 8

ESTIMATED FUEL CONSUMED BY UNITED STATES DOMESTIC CIVIL AVIATION

(In millions of gallons)

Fiscal Year	Total Jet Fuel and Aviation Gasoline	Jet Fuel			Aviation Gasoline		
		Total	Air Carrier	General Aviation	Total	Air Carrier	General Aviati
1971	8,602	8,202	7,985	217	400	22	378
1972	8,724	8,311	8,037	274	413	22	391
1973	9,035	8,603	8,299	304	432	21	411
1974	8,534	8,071	7,714	357	463	20	443
1975	8,677	8,203	7,798	405	474	20	454
1976*	9,082	8,565	8,112	453	517	20	497
1977T*	2,363	2,231	2,112	119	132	5	127
1977*	9,442	8,915	8,441	474	528	19	509
1978*	9,731	9,196	8,694	502	535	17	518
1979*	10,143	9,578	9,024	554	565	15	550
1980*	10,573	9,976	9,350	626	597	13	584
1981*	11,004	10,374	9,677	697	630	11	619
1982*	11,494	10,816	10,063	753	678	9	669

* Forecast.

Note -- Domestic civil aviation is defined for purposes of this table to include all civil aircraft flights which originate and terminate within the 50 states. Fuel consumed by airframe and aircraft engine manufacturers, whether for flight testing or ground testing, are not shown here because they are not available for the domestic industry as a whole and cannot be estimated with any assurance of accuracy. Estimates of fuel consumed by the supplemental, contract and intrastate carriers are included in the "Air Carrier" columns. It should also be noted that general aviation fuel consumption is not reported and historical series are estimates.

1977T* represents the transition quarter, July 1, 1976 through September 30, 1976.

Table 9

CIVIL AIRCRAFT PRODUCTION IN THE UNITED STATES
(Number of Aircraft)

Fiscal Year	Total	Air Carrier Transport Aircraft	General Aviation					
			Piston		Turboprop	Turbojet	Rotary Wing	Total General Aviation
			Single Engine	Twin & Multi Engine	Twin Engine	Twin & Multi Engine	Piston & Turbine	
1971	7,770	288	5,898	957	109	40	478	7,482
1972	8,799	213	6,901	1,305	132	74	444	8,586
1973	12,709	240	9,472	2,017	221	157	602	12,469
1974	15,037	307	11,092	2,158	560	199	721	14,730
1975	15,552	320	11,824	1,903	513	198	794	15,232
1976*	14,297	305	10,204	2,196	555	209	828	13,992
1977T*	3,477	71	2,300	490	89	52	200	3,406
1977*	13,768	285	9,825	2,037	577	223	821	13,483
1978*	14,925	280	10,734	2,222	607	246	836	14,645
1979*	14,856	295	10,707	2,154	611	248	841	14,561
1980*	15,281	330	10,967	2,251	625	258	850	14,951
1981*	16,072	310	11,582	2,371	667	276	864	15,762
1982*	15,055	325	10,760	2,206	635	259	870	14,730

*Forecast. 1977T is the transition quarter from July 1, 1976 through September 30, 1976.
Note -- Civil aircraft for export are included. Excludes all aircraft produced for military use whether for the United States or fo foreign government. All helicopter production, including air carrier transport helicopters, is cluded in the column for general aviation.

Table 10

CIVIL AIRCRAFT ENGINE PRODUCTION IN THE UNITED STATES

(Number of Engines)

Fiscal Year	Total	Turbojet	Turboprop	Piston
1971	11,687	1,134	625	9,928
1972	13,344	641	811	11,892
1973	18,159	688	1,220	16,251
1974	22,770	1,410	1,590	19,770
1975	22,552	1,463	2,075	19,014
1976*	19,257	1,497	2,066	15,694
1977T*	5,064	357	508	4,199
1977*	21,480	1,467	2,095	17,918
1978*	22,949	1,504	2,156	19,289
1979*	22,811	1,558	2,161	19,092
1980*	23,407	1,632	2,180	19,595
1981*	24,509	1,739	2,260	20,510
1982*	23,142	1,679	2,188	19,275

*Forecast.

1977T is the transition quarter from July 1, 1976 through September 30, 1976.

Table 11

TOTAL ITINERANT AND LOCAL AIRCRAFT OPERATIONS
AT AIRPORTS WITH FAA TRAFFIC CONTROL SERVICE

(In Millions)

Fiscal Year	Total	Itinerant	Local	Number of Towers
1971	54.2	33.6	20.6	343
1972	53.6	33.6	20.1	348
1973	53.9	34.0	19.9	362
1974	56.8	36.1	20.8	394
1975	59.0	37.6	21.4	416
1976*	63.0	40.5	22.5	428
1977T*	16.3	10.4	5.9	429
1977*	65.9	42.1	23.8	434
1978*	71.6	45.5	26.1	439
1979*	77.8	48.6	29.2	444
1980*	83.2	51.2	32.0	449
1981*	88.4	53.7	34.7	454
1982*	94.9	56.9	38.0	459

* Forecast

Note -- An aircraft operation is defined as an aircraft arrival at or a departure from an airport with FAA traffic control service. A local operation is performed by an aircraft that: operates in the local traffic pattern or within sight of the tower; is known to be departing for or arriving from flight in local practice areas; or executes simulated instrument approaches or low passes at the airport. All aircraft arrivals and departures other than local (as defined above) are classified as itinerant operations. Detail may not add to total due to independent rounding.

1977T* -- This represents activity during the transition quarter, July 1, 1976 to September 30, 1976.

Table 12

ITINERANT AIRCRAFT OPERATIONS

AT AIRPORTS WITH FAA TRAFFIC CONTROL SERVICE

(In millions)

Fiscal Year	Total	Air Carrier	Air Taxi	General Aviation	Military
1971	33.6	10.1	--	22.0	1.5
1972	33.6	9.7	2.0	20.4	1.5
1973	34.0	9.8	2.1	20.6	1.5
1974	36.1	9.5	2.4	22.9	1.3
1975	37.6	9.4	2.8	24.2	1.3
1976*	40.5	9.9	2.9	26.5	1.2
1977T*	10.4	2.5	.8	6.8	.3
1977*	42.1	10.3	3.0	27.6	1.2
1978*	45.5	10.6	3.2	30.5	1.2
1979*	48.6	11.0	3.3	33.1	1.2
1980*	51.2	11.4	3.4	35.2	1.2
1981*	53.7	11.8	3.5	37.1	1.3
1982*	56.9	12.3	3.7	39.6	1.3

* Forecast

Note -- See Table 11 for definition of itinerant operations. Detail may not add to total due to independent rounding. Air taxi included with general aviation prior to 1972.

1977T* -- This represents activity during the transition quarter, July 1, 1976 to September 30, 1976.

Table 13

LOCAL AIRCRAFT OPERATIONS

AT AIRPORTS WITH FAA TRAFFIC CONTROL SERVICE

(In millions)

Fiscal Year	Total	General Aviation	Military
1971	20.6	18.6	2.0
1972	20.1	18.1	2.0
1973	19.9	18.1	1.8
1974	20.8	19.3	1.5
1975	21.4	20.0	1.4
1976*	22.5	21.1	1.4
1977T*	5.9	5.5	.4
1977*	23.8	22.4	1.4
1978*	26.1	24.7	1.4
1979*	29.2	27.8	1.4
1980*	32.0	30.6	1.4
1981*	34.7	33.3	1.4
1982*	38.0	36.6	1.4

* Forecast

Note -- See Table 11 for definition of local operations. Detail may not add to total due to independent rounding.

1977T* -- This represents activity during the transition quarter, July 1, 1976 to September 30, 1976.

Table 14

INSTRUMENT OPERATIONS AT AIRPORTS
WITH FAA TRAFFIC CONTROL SERVICE
(In millions)

Fiscal Year	Total	Air Carrier	Air Taxi	General Aviation	Military	Number TCA's
1971	17.5	9.5	--	4.6	3.4	3
1972	19.4	9.6	.9	5.0	3.9	7
1973	22.0 (1.5)	9.8	1.1	7.4	4.2	10
1974	24.1 (2.6)	9.5	1.4	9.2	4.0	17
1975	26.2 (2.9)	9.5	1.9	10.8	4.0	22
1976*	27.2 (3.9)	9.9	1.9	11.5	3.9	23
1977T*	6.9 (.9)	2.5	.5	2.9	1.0	23
1977*	28.6 (3.9)	10.3	2.0	12.3	4.0	23
1978*	31.1 (3.9)	10.6	2.2	14.3	4.0	23
1979*	33.6 (4.0)	11.0	2.2	16.4	4.0	23
1980*	35.5 (4.0)	11.4	2.4	17.8	3.9	23
1981*	37.4 (4.0)	11.8	2.5	19.1	4.0	23
1982*	39.7 (4.0)	12.3	2.7	20.8	3.9	23

* Forecast

Note -- An instrument operation is defined as the handling by an FAA terminal traffic control facility of the arrival, departure, or over at an airport of an aircraft on an IFR flight plan or the provision of IFR separation to other aircraft by an FAA terminal traffic control facility. Non IFR instrument counts at Terminal Control Area (TCA) facilities and Stage III of expanded area radar service are included in the totals. However, Stage III counts are noted in parenthesis as an information item.

Includes instrument operations at FAA-operated military radar approach control facilities.

Air taxi included with general aviation prior to 1972.

1977T* -- This represents activity during the transition quarter, July 1, 1976 to September 30, 1976.

Table 15

IFR AIRCRAFT HANDLED, IFR DEPARTURES, AND OVERS BY USER CATEGORY

FAA AIR ROUTE TRAFFIC CONTROL CENTERS

(In millions)

Fiscal Year	Total			Air Carrier			Air Taxi			General Aviation			Military		
	Aircraft Handled	IFR Departures	Overs	Aircraft Handled	IFR Departures	Overs	Aircraft Handled	IFR Departures	Overs	Aircraft Handled	IFR Departures	Overs	Aircraft Handled	IFR Departures	Overs
1971	21.3	8.2	5.0	13.0	4.9	3.1				3.8	1.6	.5	4.6	1.4	1.4
1972	22.0	8.5	5.1	12.4	4.6	3.2	.8	.4	0	3.9	1.7	.6	4.9	1.8	1.4
1973	22.8	8.9	5.1	12.6	4.7	3.2	.9	.4	0	4.6	2.0	.6	4.7	1.7	1.2
1974	22.9	9.0	4.9	12.4	4.6	3.1	1.1	.5	0	5.1	2.2	.7	4.3	1.6	1.1
1975	23.6	9.3	5.1	12.4	4.6	3.1	1.3	.6	.1	5.5	2.4	.7	4.4	1.6	1.2
1976*	24.7	9.8	5.1	13.2	5.0	3.2	1.5	.7	.1	6.1	2.6	.9	3.9	1.5	.9
1977T*	6.3	2.5	1.3	3.3	1.2	.9	.4	.2	0	1.6	.7	.2	1.0	.4	.2
1977*	25.6	10.2	5.2	13.6	5.2	3.2	1.5	.7	.1	6.5	2.8	.9	4.0	1.5	1.0
1978*	26.7	10.7	5.3	13.9	5.3	3.3	1.7	.8	.1	7.1	3.1	.9	4.0	1.5	1.0
1979*	28.0	11.2	5.6	14.5	5.5	3.5	1.9	.9	.1	7.6	3.3	1.0	4.0	1.5	1.0
1980*	29.0	11.6	5.8	15.1	5.7	3.7	2.1	1.0	.1	7.9	3.4	1.1	3.9	1.5	.9
1981*	30.6	12.3	6.0	15.6	5.9	3.8	2.5	1.2	.1	8.5	3.7	1.1	4.0	1.5	1.0
1982*	32.3	13.0	6.3	16.4	6.2	4.0	2.7	1.3	.1	9.2	4.0	1.2	4.0	1.5	1.0

*Forecast

Note -- Detail may not add to total due to independent rounding. The aircraft handled count consists of the number of IFR departures multiplied by two plus the number of overs. This concept recognizes that for each departure there is a landing. An IFR departure is defined as an original IFR flight plan filed either prior to departure or after becoming airborne. An over flight originates outside the ARTC area and passes through the area without landing. The forecast data assume present operating rules and procedures and a reduction of one ARTCC in 1975. Air taxi included with general aviation prior to 1972.

1977T* - This represents activity during the transition quarter, July 1, 1976 to September 30, 1976.

Table 16

TOTAL FLIGHT SERVICES, PILOT BRIEFS

AND FLIGHT PLANS ORIGINATED

FAA FLIGHT SERVICE STATIONS AND COMBINED STATION/TOWERS

(In millions)

Fiscal Year	Total Flight Services	Pilot Briefs	Flight Plans Originated		
			Total	IFR-DVFR	VFR
1971	47.7	12.7	6.2	3.5	2.7
1972	50.4	13.5	6.6	3.9	2.7
1973	53.7	14.7	7.2	4.5	2.7
1974	56.2	15.4	7.8	5.0	2.8
1975	58.3	16.2	8.0	5.2	2.8
1976*	67.0	19.0	9.1	5.9	3.2
1977T*	17.8	5.1	2.3	1.5	.8
1977*	72.9	20.8	9.6	6.3	3.3
1978*	80.2	23.2	10.2	6.8	3.4
1979*	85.8	25.1	10.7	7.1	3.6
1980*	89.9	26.6	11.0	7.3	3.7
1981*	96.3	28.8	11.5	7.5	4.0
1982*	104.4	31.4	12.3	8.1	4.2

* Forecast

Note -- Total Flight Services is a weighted workload measurement derived by multiplying pilot briefs and flight plans originated by two and adding the number of aircraft contacted. A flight plan may be filed orally or in writing to qualify for inclusion in the activity count. The data forecast in Tables 13 and 17 are based upon the current number and configuration of the FSS and CS/T. Any change in their number of operation would have a corresponding change on the forecast. Detail may not add to total due to independent rounding.

1977T* -- This represents activity during the transition quarter, July 1, 1976 to September 30, 1976.

Table 17

AIRCRAFT CONTACTED

FAA FLIGHT SERVICE STATIONS AND COMBINED STATION/TOWERS

(In millions)

Fiscal Year	Total	IFR-DVFR	VFR	Air Carrier	Air Taxi	General Aviation	Military
1971	9.9	1.3	8.6	.7	--	8.6	.7
1972	10.0	1.4	8.6	.5	.6	8.2	.7
1973	9.9	1.5	8.4	.6	.7	8.0	.7
1974	9.9	1.5	8.4	.4	.7	8.1	.7
1975	10.0	1.6	8.4	.4	.8	8.1	.7
1976*	10.8	2.2	8.6	.4	.9	8.8	.7
1977T*	3.0	.6	2.4	.1	.2	2.5	.2
1977*	12.1	2.5	9.6	.4	1.0	10.0	.7
1978*	13.4	3.1	10.3	.4	1.2	11.1	.7
1979*	14.2	3.7	10.5	.4	1.3	11.8	.7
1980*	14.7	4.0	10.7	.4	1.3	12.3	.7
1981*	15.7	4.4	11.3	.4	1.4	13.2	.7
1982*	17.0	4.8	12.2	.4	1.4	14.5	.7

* Forecast

Note -- Aircraft contacted represent a record of the number of aircraft with which FAA facilities (FSS, CS/T) have established radio communications contact. One count is made for each en route, landing or departing aircraft contacted by a facility, regardless of the number of contacts made with an individual aircraft. A flight involving contacts with five different facilities, disregarding the number of contacts with each, would be counted as five aircraft contacted. Detail may not add to total due to independent rounding. Air taxi included with general aviation prior to 1972.

1977T* -- This represents activity during the transition quarter, July 1, 1976 to September 30, 1976.

Table 18

ACTIVE PILOTS BY TYPE OF CERTIFICATE

As of January 1	Total	Students	Private	Commercial	Airline Transport	Helicopter	Glider	Instrument Rated 1/
1971	732,729	195,861	305,826	186,821	34,431	6,677	3,114	169,848
1972	741,009	186,428	314,660	192,409	35,949	7,992	3,571	179,261
1973	750,869	181,477	323,383	196,228	37,714	7,987	4,080	187,909
1974	714,607	181,905	301,863	182,444	38,139	5,968	4,288	148,242
1975	730,541	180,795	305,848	192,425	41,002	5,647	4,824	199,323
1976*	758,400	187,200	322,000	195,900	41,900	5,900	5,500	204,900
1977*	800,400	199,300	346,300	199,300	43,100	6,200	6,200	210,700
1978*	833,700	214,000	358,800	202,900	44,500	6,500	7,000	216,600
1979*	822,100	226,400	388,800	206,500	45,900	6,600	7,900	222,700
1980*	905,100	234,000	398,300	210,200	47,100	6,700	8,800	229,000
1981*	942,800	242,600	422,300	213,000	48,200	6,800	9,900	233,000
1982*	1,001,200	256,800	442,600	235,000	49,000	6,900	10,900	250,000

* Forecast 1/ Not included in total

Note -- The total count includes all pilots with current medical certificates; it also includes pilots who no longer fly but desire to keep their active status by periodic medical examinations. At the close of 1973 the active pilot count totalled 714,607, compared with 750,869 at the end of 1972. The decrease in the number of airmen resulted from a purging of the Airmen Certification files. During this process approximately 26,000 duplicates or faulty records were eliminated.

LONG TERM FORECASTS

Fiscal Years 1986-1987

While short-term planning requires a single forecast, long-term plans must anticipate changes in activity resulting from variations in economic conditions. The cumulative impact of various economic conditions can have a significant effect on planning in the long-term. In order to bracket the wide range of aviation activity levels which can be anticipated, three alternative projections have been made.

The first is the BASELINE forecast. For this forecast the economy is assumed to reverse its downward trends by the fourth quarter of 1975 with slow recovery scheduled for 1976 and 1977. As expansion continues to accelerate, a long-term real income growth rate of 3 percent per year and an unemployment rate of 6 percent is predicted. At the same time, a coordinated national energy policy will become effective by the early 1980's. By reducing fuel related price increases, this program will contribute to a long-term inflation rate below current levels at 5 percent.

The second forecast anticipates QUICK RECOVERY. Vis-a-vis the Baseline scenario, this case assumes an effective fiscal program which results in full recovery beginning in 1977, a higher real income growth rate of around 3.5 percent per year, and reductions of unemployment to 5 percent. As in the previous case, an effective energy policy is assumed. Increases in demand caused by higher income levels are expected to raise prices by 5.5 percent per year.

The SLOWER RECOVERY forecast assumes a long-term real income growth of 2.5 percent. Fuel shortages combined with reductions in productivity and attempts to increase growth through fiscal and monetary policy tools are assumed to result in annual inflation rates of 6 percent. A continuing unemployment rate of 8 percent also characterizes this scenario.

Table 19

BASELINE LONG TERM FORECAST

Fiscal Years 1986-1987

	1986	1987
Scheduled Domestic Passenger Traffic		
Revenue Passenger Miles (Billions)	262.7	280.0
Revenue Passenger Enplanements (Millions)	360.8	384.1
Fleet Size		
Air Carrier	3,432	3,542
General Aviation	245,000	256,000
Hours Flown (Millions)		
Air Carrier	8.96	9.28
General Aviation	57.50	60.43
Tower Operations (Millions)		
Total	116.8	124.8
Itinerant	68.1	72.1
Air Carrier	13.9	14.4
Air Taxi	4.7	4.8
General Aviation	48.1	51.5
Military	1.4	1.4
Local	48.7	52.7
General Aviation	47.3	51.3
Military	1.4	1.4
Instrument Operations (Millions)		
Total	48.1	50.9
Air Carrier	13.9	14.4
Air Taxi	3.5	3.6
General Aviation	26.7	28.9
Military	4.0	4.0
IFR Aircraft Handled (Millions)		
Total Handled	37.5	39.4
Total Departures	15.2	15.8
Total Overs	7.5	7.8
Air Carrier Handled	18.2	18.8
Air Taxi Handled	3.2	3.4
General Aviation Handled	12.5	13.2
Military Handled	4.0	4.0
Flight Services (Millions)		
Total	132.9	143.6
Pilot Briefs	39.7	43.4
Flight Plans Originated	15.6	16.5
Aircraft Contacted	22.3	23.8

Table 20

QUICK RECOVERY FORECAST

Fiscal Years 1986-1987

	1986	1987
Scheduled Domestic Passenger Traffic		
Revenue Passenger Miles (Billions)	278.4	296.8
Revenue Passenger Enplanements (Millions)	380.3	402.7
Fleet Size		
Air Carrier	3,601	3,861
General Aviation	262,000	274,000
Hours Flown (Millions)		
Air Carrier	9.41	10.10
General Aviation	61.54	64.68
Tower Operations (Millions)		
Total	123.5	133.0
Itinerant	72.0	77.3
Air Carrier	14.6	15.7
Air Taxi	4.9	5.0
General Aviation	51. 1	55.2
Military	1.4	1.4
Local	51.5	55.7
General Aviation	50.1	54.3
Military	1.4	1.4
Instrument Operations (Millions)		
Total	50.9	54.8
Air Carrier	14.6	15.7
Air Taxi	3.6	3.7
General Aviation	28.7	31.4
Military	4.0	4.0
IFR Aircraft Handled (Millions)		
Total Handled	39.8	41.6
Total Departures	15.9	16.6
Total Overs	8.0	8.4
Air Carrier Handled	19.0	20.2
Air Taxi Handled	3.3	3.5
General Aviation Handled	13.5	13.9
Military Handled	4.0	4.0
Flight Services (Millions)		
Total	139.8	152.4
Pilot Briefs	41.7	46.0
Flight Plans Originated	16.5	17.6
Aircraft Contacted	23.4	25.2

Table 21

SLOWER RECOVERY FORECAST

Fiscal Years 1986-1987

	1986	1987
Scheduled Domestic Passenger Traffic		
Revenue Passenger Miles (Billions)	246.9	260.4
Revenue Passenger Enplanements (Millions)	339.6	357.2
Fleet Size		
Air Carrier	3,382	3,468
General Aviation	228,000	238,000
Hours Flown (Millions)		
Air Carrier	8.83	9.10
General Aviation	53.21	55.86
Tower Operations (Millions)		
Total	109.5	114.8
Itinerant	64.6	67.2
Air Carrier	13.7	14.1
Air Taxi	4.6	4.7
General Aviation	45.0	47.1
Military	1.3	1.3
Local	44.9	47.6
General Aviation	43.5	46.2
Military	1.4	1.4
Instrument Operations (Millions)		
Total	46.8	48.8
Air Carrier	13.7	14.1
Air Taxi	3.5	3.6
General Aviation	25.8	27.3
Military	3.8	3.8
IFR Aircraft Handled (Millions)		
Total Handled	37.1	38.1
Total Departures	15.0	15.4
Total Overs	7.1	7.3
Air Carrier Handled	18.0	18.4
Air Taxi Handled	3.2	3.4
General Aviation Handled	12.1	12.5
Military Handled	3.8	3.8
Flight Services (Millions)		
Total	123.4	131.5
Pilot Briefs	36.5	39.5
Flight Plans Originated	14.7	15.3
Aircraft Contacted	21.0	21.9

APPENDIX A

MACRO AIR CARRIER FORCASTING MODEL

Jonathan C. Tom

March 7, 1975

To facilitate FAA manpower and facility planning, forecasts of air carrier activity are necessary. Because of the interrelationships among the economic and aviation variables, a multiple equation econometric model has been developed to derive the forecasts. The first part of this discussion deals with the variables used in the model and the structural relationships among them. The second reviews the estimation results. The economic and aviation assumptions of the forecasts are discussed in the third part.

The Model

The historical data covers, on a quarterly basis, the period from the first quarter of 1964 to the third quarter of 1974. This time period was chosen in an attempt to eliminate the effects of the transition from prop to jet aircraft.

The endogenous variables forecasted were -

1. RPM - Scheduled domestic revenue passenger miles are used to reflect demand for air travel. The data were computed as a quarterly total and include activity from all certificated domestic route air carriers.

2. ENP - Another measure of demand for air travel is scheduled domestic revenue passenger enplanements. Also computed on a quarterly basis, this variable reflects numbers of passengers boarding scheduled domestic flights.

3. OPS - Air carrier itinerant operations at airports with FAA air traffic control service reflect the useage of FAA facilities. The historical

figures again are quarterly totals.

The structural form of the model is -

1. RPM = f (SRVC. APSU, PAT, REL, STR)

2. ENP = g (CMP, APSU, PAT, REL, STR)

3. OPS = h (RPM, LOAD, SEATS, STAGE)

Equations 1 and 2 are linear equations, while equation 3 is an identity relating to RPM and OPS.

The exogenous variables used in the model are -

1. SRVC - Because the use of air transportation is the consumption of a service, income used for the personal consumption of services can be used to represent the income effect on demand. SRVC should then be positively related to RPM.

2. CMP - The number of civilians employed reflects that portion of the population which would use air carrier services. As the level of CMP increases so should the level of ENP.

3. APSU - Purchases of automobiles represent the use of alternative modes of transportation. This variable should be negatively related to demand, since, as the alternative modes are used more frequently, the use of air transport will diminish.

4. PAT - This variable measures plant, equipment, and other investment in the air transport industry. Given that such investment leads to an improvement in the level of service, PAT should be positively related to demand.

5. REL - The price of air transportation relative to that of other modes of transportation should have a negative impact on demand. As air fares decline relative to the cost of automotive transportation, the quantity of service demanded will increase. REL then is a ratio between a price index for adult coach fares and an index for the cost of private transportation. Both of these indexes are based on 1967 dollars.

6. STR - This dummy variable is used to estimate the effect of major airline strikes on the demand for air travel. The period most affected by a strike was the third quarter of 1966. The variable is one during this period, and zero otherwise.

7. LOAD, SEAT, STAGE - The average load factor, the average number of seats per aircraft, and the average stage length are all parts of the identity relating RPM and OPS. These variables represent data for scheduled domestic certificated route air carriers.

Note that the two measures of demand have different specifications. Since the number of enplanements is limited by the number of people able to fly, CMP is the appropriate variable. Since the distance flown is limited by income rather than population, on the other hand, SRVC should be used to explain RPM.

The Estimation

An ordinary least squares regression technique was used to estimate equations 1 and 2. The relationship between the endogenous and exogenous variables was assumed linear for both measures of demand. A log linear formulation was not chosen because it assumes a compounding growth rate. Since the industry appears to have explored most of its markets, rapid growth resulting from expansion into new markets is no longer expected. The linear form reflects the

behavior of a mature industry whose growth is now dependent on general economic growth rather than the discovery of new markets. The estimated equations are -

Estimated ENP = -75.01 + 1.64*CMP - 0.04*APSU + 1.98*PAT
(15.75) (-1.76) (3.04)
-0.17*REL - 5.79*STR
(-1.62) (-2.52)

Durban-Watson Statistic = 1.487
Corrected R-squared = 0.944
Standard Error = 2.129

Estimated RPM = -12.32 + 0.32*SRVC - 0.06*APSU
(17.35) (-3.94)
+0.56*PAT - 0.17*REL - 4.18*STR
(1.17) (-2.18) (-2.63)

Durban-Watson Statistic = 1.791
Corrected R-squared = 0.955
Standard Error = 1.479

The numbers in parentheses are Student t-statistics corresponding to each coefficient. Note that all coefficients are of expected sign, substantiating the a priori hypotheses. The corrected r-squares indicate that the models explain about 95 percent of the variance in the dependent variables. The Durban-Watson statistics indicate that serial correlation is not significant at a 1 percent level. Therefore, these models do explain the historical demand for air carrier services. Given that the estimated relationships continue into the future, the equations can be used for forecasting.

The Forecast Assumptions

The assumptions and forecasted economic variables tie to those used by the Council of Economic Advisors and were used as the base line scenario for the required projected levels of the exogenous variables. The forecast

assumes that economic recovery will begin in late 1975 and continue until 1980 when the economy will return to the normal growth path. The impact of these increases in real income will not be felt in the air carrier industry however, because of the increased consumption of consumer durables. Since people will begin to make durable purchases, which have been postponed during the recession, SRVC will remain low through 1980.

As income grows, the employed population will remain fairly stable throughout the forecast period. Two offsetting effects will contribute to this. Early retirement will decrease the employed population, while the return of the unemployed to the labor force will increase it. Moreover, because the postwar baby boom has already entered the labor market, the recent upsurge in the employable population will be reduced.

In the meantime, continuing restraints on fuel consumption will increase the cost of private automobile transportation. As the airlines maintain a policy of holding down fares to encourage demand, the price of air transportation falls relative to the cost of alternative modes.

Consistent with the increases in real incomes and the consumption of consumer durables, purchases of automobiles rise until the late 1970's. Then, as gasoline costs continue to rise and as the price of new automobiles increases, APSU will begin falling off in the 1980's.

In addition to these economic assumptions, some assumptions about airline behavior were made. Because of decreases in the relative price of air fares and increases in operating costs, the air carriers will attempt to maintain a load factor which will increase gradually through the mid-fifties during the forecast period. Consistent with increasing costs, airlines will retain older aircraft and no longer add seats to existing aircraft. At the same time, to

maintain frequency levels, the use of wide-bodied aircraft will be reduced from levels anticipated in the early 1970's. These latter three assumptions imply that the average seats per aircraft will increase slower than forecasted in previous years. Finally, a gradually increasing average stage length was assumed.

APPENDIX B

GENERAL AVIATION FORECASTING MODEL

Thomas Henry, Steve Vahovich, and Jonathan Tom

March 7, 1975

I. INTRODUCTION

Significant growth in the size of the general aviation fleet during the sixties, and the relatively recent trend toward larger multi-engine and turbine powered fixed wing aircraft, have lead to increased intensity of use of the National Aviation System (NAS) by general aviation aircraft. The effect of increased fleet size and the trend toward larger general aviation aircraft is reflected in the increase in general aviation operations (takeoffs and landings) at Federal Aviation Administration (FAA) towered airports -- between 1959 and 1972 general aviation operations almost tripled in size (growth in air carrier operations over the same period was only 32%), and general aviation currently accounts for over 80% of total aircraft operations at towered airports in the United States. Since general aviation represents such a significant component of NAS, forecasts of general aviation activity are critical measures of future demands on NAS. Thus, the forecasting model presented in this paper represents an important basis for aviation planning purposes.

The structure of this paper is as follows: Section II discusses the model and relevant economic hypotheses; Section III presents the empirical results; and Section IV discusses the general economic assumptions upon which the forecasts are based.

II. MODEL AND HYPOTHESES

The fundamental assumptions underlying the general aviation model are that the various measures of general aviation activity are related to the level of economic activity, and that the various activity measures are dependent on one another in a specific (i.e., without feedback) way. The latter assumption

accounts for the construction of the model as a recursive system (see Johnston, Econometric Methods, p. 377) and justifies the estimation technique.

Figure A incorporates these assumptions and illustrates the general structure of the model. Figure B defines the endogenous and exogenous variables in the model, and Figure C presents the system of equations summarizing the behavioral assumptions included in the model. Since the same exogenous variable may appear in more than one equation, with the same expected sign, the following detailed discussion of the associated behavioral hypothesis is presented with respect to all relevant endogenous variables. A discussion of the recursive relationships follows the presentation of the hypotheses.

Since the number of active general aviation aircraft (GAAA) is likely to increase as the number of civilians employed increases, the expected sign for the parameter estimate of CMP is positive. Expenditure on aircraft plant and complementary equipment (PAC), a surrogate measure of the sales of aircraft and complementary equipment, is expected to be positively related to the number of active general aviation aircraft (GAAA), the number of student pilots (STD), and the number of itinerant operations (ITN). Factory sales of automobiles (SUB), a surrogate measure for the effect of alternative modes of transportation, is expected to be negatively related to the number of general aviation aircraft (GAAA) and the number of active student pilots (STD) -- the more widespread automobile use, the fewer the number of general aviation aircraft and the fewer the number of student pilots.* Since it is likely that the number of active student pilots (STD) will increase as real per capita disposable personal income increases, a positive sign is expected for PPDPI. The availability of aircraft to instrument rated pilots (AVAIL) is expected to be positively related to the number of IFR flight plans filed (IFRF) -- the greater the aircraft availability, the greater the number of flight plans filed.

*Since SUB and real liquid assets (a measure of wealth) are not highly correlated, the alternative hypothesis suggesting a positive relationship between SUB and GAAA and STD was rejected.

FIGURE A
General Aviation Forecasting Model

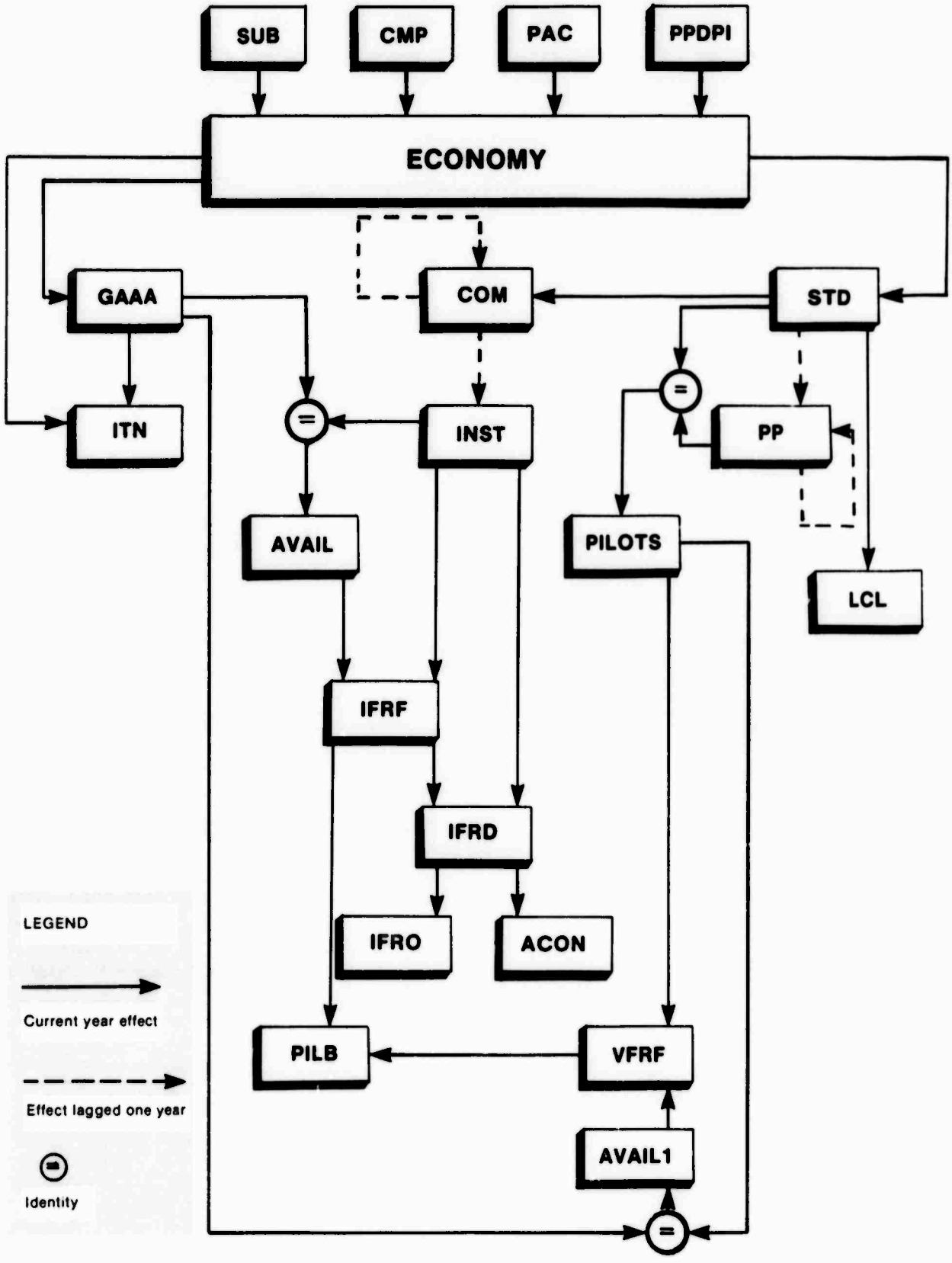


Figure B: Endogenous and Exogenous Variables in the Model

Endogenous Variables	Definition
GAAA	Number of general aviation aircraft
PP, STD, INST	Number of active private, student, and instrument rated pilots, respectively
COM	Sum of the number of active private and commercial pilots
ITN, LCL	Number of itinerant and local operations, respectively. General aviation and air taxi operations are included in these measures of activity at airport traffic control towers
IFRD, IFRO	Number of instrument flight rule (IFR) departures and over flights, respectively. General aviation and air taxi operations are included in these measures of activity at air route traffic control centers
IFRF, VFRF	Number of IFR and visual flight rule (VFR) flight plans filed
PILB	Number of pilot briefs
ACON	Number of aircraft contacted. General aviation, air taxi, air carrier, and military are included in this measure of activity at flight service stations
INSTOP	Number of instrument operations. General aviation, air taxi, air carrier and military are included in this measure of activity at airports with FAA control service

Exogenous Variables	Definition
CMP	Number of civilians employed.
PAC	Plant and equipment expenditures in aircraft industry.
SUB	Factory sales of automobiles.
PPDPI	Per capita dispensable personal income in constant 1958 dollars.
AVAIL	Ratio of the number of general aviation aircraft to the number of instrument rated pilots (estimated).
AVAIL1	Ratio of the number of general aviation aircraft to the sum of the number of active student and private pilots (estimated).
PILOTS	Sum of active student and private pilots (estimated).
CLEAN	Equal to 1 if year is 1973 or greater and zero otherwise.
VALID	Equal to 1 if year is 1973 and zero otherwise.

Figure C: General Aviation Forecasting Model*

$$GAAA = a_1 + b_1\ CMP + b_2\ PAC + b_3\ SUB + U_1$$

$$STD = a_2 + b_4\ PPDPI + b_5\ PAC + b_6\ SUB + b_7\ CLEAN + U_2$$

$$INST = a_3 + b_8\ LICOM + b_9\ VALID + U_3$$

$$ITN = a_4 + b_{10}\ PAC + b_{11}\ GAAAF + U_4$$

$$LCL = a_5 + b_{12}\ STDF + U_5$$

$$IFRF = a_6 + b_{13}\ INSTF + b_{14}\ AVAIL + U_6$$

$$IFRD = a_7 + b_{15}\ IFRFF + b_{16}\ INSTF + U_7$$

$$IFRO = a_8 + b_{17}\ IFRDF + U_8$$

$$VFRF = a_9 + b_{18}\ AVAIL1 + b_{19}\ PILOTS + U_9$$

$$PILB = a_{10} + b_{20}\ VFRFF + b_{21}\ IFRFF + U_{10}$$

$$ACON = a_{11} + b_{22}\ IFRDF + U_{11}$$

$$PP = a_{12} + b_{23}\ L1PP + b_{24}\ L1STD + b_{25}\ CLEAN + U_{12}$$

$$COM = a_{13} + b_{26}\ L1COM + b_{27}\ STDF + b_{28}\ CLEAN + U_{13}$$

** $INSTOP = a_{14} + ACITN + b_{29}\ ITN + MILITN$

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* See Figure B for the definitions of the acronyms used in Figure C. The prefix "L1" attached to a previously defined variable indicates that the variable is lagged one period, and the suffix "F" attached to a previously defined variable indicates that the estimated value of the variable is used as an independent variable. U_i represents the random error term.

** This equation is an identity. A description of its components is presented in Section III.

Similarly, the greater the availability of aircraft to student and private pilots, (AVAIL1), the greater the expected number of VFR flight plans filed (VFRF). Since students and private pilots are most likely to fly VFR, the greater the number of student and private pilots (PILOTS), the greater the number of VFR flight plans filed (VFRF).

The dummy variables CLEAN and VALID are included in the model to capture the effects of file cleaning operations by FAA, Data Services Division. For 1973 data, the airman file was purged such that duplicate records were eliminated. Whereas, prior to 1973 a pilot may have been recorded on file as containing both a private and a student pilot rating, the 1973 purge and all subsequent up-dates to this file would count this pilot only as a private pilot. Since the effect of this purge is to reduce the previously artificially-inflated count in each of the various pilot classifications, CLEAN is expected to be negatively related to STD, PP, and COM. The dummy variable VALID derives its origin from the fact that the instrument rated pilot subsection of the airman file was further scrutinized for the number of instrument rated pilots who held current instrument ratings (i.e., passed yearly examinations, and met other requirements). Those pilots not maintaining current valid status were removed from the instrument rated file for the year 1973, and were reinstated to the file upon fulfilling the current requirements. Since this procedure temporarily reduced the number of active instrument rated pilots, the expected sign of the parameter estimate of VALID is negative for the INST estimating equation.

Figure A shows that certain dependent variables are recursively related to other endogenous variables in the model and to lagged values of the endogenous variables. The former effect is demonstrated by the direction of the solid-line arrows, and the latter relationship is demonstrated by the broken-line arrows. Since the theoretical justification for inclusion of the lagged variables in the model is relatively straightforward, individual discussion of these hypotheses is not necessary -- all of the lagged variables are expected to have positive signs for their respective parameter estimates. The recursive

relationships require some additional discussion.*

Since most local operations (LCL) can be attributed to student pilots, STDF is expected to be positively related to the number of local operations. Similarly, the parameter estimates of STDF is expected to be positive in the COM estimating equation. That is, since student classification is a prerequisite to both private and commercial pilot status, the number of private and commercial pilots is likely to increase as the number of student pilots increase. Since only instrument rated pilots can fly under instrument flight rules, the number of instrument rated pilots (INSTF) is expected to be positively related to both the number of instrument flight plans filed (IFRF) and the number of instrument flight departures (IFRD). In addition, the number of instrument flight plan departures is likely to increase with the number of instrument flight plans filed -- a positive sign for the parameter estimate of IFRFF. Since the number of instrument departures is directly related to the number of IFR over flights (IFRO), the expected sign of the parameter estimate of IFRDF is positive. Similarly, the number of instrument flight departures (IFRDF) is expected to be a positive determinant of the number of aircraft contacted (ACON). Since flight plans filed generally indicate an impending flight and consequent pilot briefs, the number of pilot briefs (PILB) are likely to increase as the number of instrument (IFRFF) and visual (VFRFF) flight rule flight plans filed increase. Finally, it is likely that the number of general aviation aircraft will be positively related to the number of itinerant operations (ITN), thus, a positive sign is expected for the parameter estimate of GAAA.

III. RESULTS

The results of the regression equations are presented in Figure D. In general,

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*The suffix "F" attached to a previously defined endogenous variable indicates that the predicted value of that variable was used as an independent variable in the specified equation.

the results show that a high degree of confidence may be placed in the model. Without exception, the signs of the parameter estimates are as hypothesized in Section III and the Durban-Watson statistics indicate that, with the exception of three equations, there is no positive or negative first-order autocorrelation. For the VFRF, PP, and COM estimating equation the Durban-Watson test is inconclusive. All but a few of the estimated parameters are significant (See Table 3, t - test) at the .95 level of confidence or better, and the majority are significant at the .99 level. The R - squares, indicating the amount of the variance in the dependent variables explained or accounted for by the independent variables, are very respectable. Further interpretation of the particulars of the estimating equations presented in Figure D is left to the reader.

As previously noted, the instrument operations equation (INSTOP) in Figure D is an identity. The parameter $^{a}14$ varies between 3.5 and 3.7 over time, and is intended to account for expected increases in the number of airport towers becoming stage-three control areas -- pilots flying into Stage III control areas must fly IFR. The parameter $^{b}29$ varies between .32 and .49 over time, and is intended to account for the expected increase in the level of pilot sophistication. That is, it accounts for the effect of increases in the number of instrument rated pilots and the increased use of avionics. The variables ACITN, ITN, and MILITN represent the number of air carrier, air taxi and general aviation, and military itinerant operations, respectively.

IV. ASSUMPTIONS FOR FORECAST YEARS: 1974-87

The estimating equations presented in Section III were used to derive forecasts of the endogenous variables for the years 1975 through 1987. The assumptions and forecasted economic variables tie to those used by the Council of Economic Advisors and were used as the base line scenario for the required projected levels of the exogenous variables. The forecast

assumes that the economy will continue to decline into 1975, bottoming out about mid-1975, then carrying the recovery forward into 1976. The economy will eventually return to a growth path, but improvement will be gradual.

Real personal disposable income is expected to increase as a result of expansive fiscal policies. The total personal income tax cut is expected to be in the neighborhood of $10 billion. Investment spending is likely to increase because of congressional approval of the Administration's request that the investment tax credit be raised from 7 to 10 percent. Similarly, expected expansionary fiscal policies will combat rising unemployment. However, because of projected excess production capacity through 1975 and 1976, civilian employment will not show any striking immediate increases during this period. Unemployment is expected to hover around 7 percent until late 1976. Total industrial production is expected to resume positive full year growth during 1976, and a modest recovery in factory sales of automobiles is expected to occur in 1975 and thereafter.

Figure D: Estimating Equations for the General Aviation Forecasting Model*

GAAA = - 1965.16+43.10 CMP + 33.27 PAC- 0.02 SUB
(31.79) (1.09) (-2.24)
D-W=1.64 Corrected R - square = .99

STD = - 139.57+1.18 PPDPI+ 68.65 PAC - 0.01 SUB - 33.81 CLEAN
(9.30) (4.66) (- 0.70) (- 2.54)
D-W=1.84 Corrected R - square = .94

INST = - 27.22+0.42 L1COM - 40.17 CLEAN
(41.65) (- 9.48)
D-W=1.79 Corrected R - square = .99

ITN = - 74.90+53.49 PAC + 0.20 GAAAF
(4.67) (19.67)
D-W=1.53 Corrected R - square = .98

LCL = - 56.10+1.27 STDF
(21.55)
D-W=2.31 Corrected R - square = .97

IFRF = - 14258.42+57.48 INSTF + 10.25 AVAIL
(12.64) (8.14)
D-W=1.98 Corrected R - square = .95

IFRD = - 727.34+0.53 IFRFF +3.73 INSTF
(7.54) (2.06)
D-W=2.08 Corrected R - square = .96

IFRO = 46.05+.27 IFRDF
(19.68)
D-W=2.01 Corrected R - square = .97

VFRF = - 2047.75+7.44 AVAIL1 + 5.56 PILOTS
(2.37) (7.45)
D-W=1.17 Corrected R - square = .86

PILB = - 1485.22+0.86 VFRFF + 0.12 IFRFF
(6.82) (2.25)
D-W=2.73 Corrected R - square = .99

ACON = 63.64+0.37 IFRDF
(17.72)
D-W=2.71 Corrected R - square = .97

$$PP = 5.77 + 0.77\ LIPP + 0.40\ L1STD - 24.48\ CLEAN$$
$$(4.35) \qquad (1.46) \qquad (-1.63)$$
D-W=2.71 Corrected R - square = .97

$$COM = -9.63 + 0.75\ L1COM + 0.77\ STDF - 37.14\ CLEAN$$
$$(17.18) \qquad (7.12) \qquad (-4.08)$$
D-W=2.57 Corrected R - square = .99

$$**INSTOP = A_{14} + ACITN + b_{29}\ ITN + MILITN$$

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* See footnotes at bottom of Figure C. The t-values are in parenthesis, and D-W indicates the Durban-Watson statistic. The analysis interval is 1960-73 and data was collected on an annual basis.

** This equation is an identity. A description of its components is presented in the text of this section.