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A STUDY OF THE FINANCIAL HISTORY OF THE U. S. SCHEDULED AIRLINES AND THE IMPROVEMENT OF AIRLINE PROFITABILITY THROUGH TECHNOLOGY

Darrell E. Wilcox

Ames Research Center
Moffett Field, California 94035

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16 Abstract

The financial history of the U.S. scheduled airline industry was investigated to determine the causes of the erratic profit performance of the industry and to evaluate potential economic gains from technology advances of recent years. Operational and economic factors affecting past and future profitability of the industry are discussed, although no attempt was made to examine the profitability of individual carriers. The results of the study indicate that the profit erosion of the late 1960's and early 1970's was due more to excess capacity than to inadequate fare levels, but airline problems were severely compounded by the rapid fuel price escalation in 1974 and 1975. Near-term solutions to the airline financial problems depend upon the course of action by the industry and the CAB and the general economic health of the nation. For the longer term, the only acceptable alternative to continued fare increases is a reduction in unit operating costs through technological advance. The next generation of transports is expected to incorporate technologies developed under Government sponsorship in the 1960's and 1970's, with significant improvements in fuel consumption and operating costs.

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A STUDY OF THE FINANCIAL HISTORY OF THE U.S. SCHEDULED AIRLINES AND THE IMPROVEMENT OF AIRLINE PROFITABILITY THROUGH TECHNOLOGY

BY

Darrell E. Wilcox
NASA-Ames Research Center
Moffett Field, CA 94035

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SUMMARY

The financial history of the U. S. airline industry has been characterized by continuous growth of revenue but irregular profitability. The recent past has been a particularly difficult period. Concern over the future financial viability of the industry leads one to question the causes of past difficulties. For this reason, a study of the financial history of the U. S. scheduled airline industry has been performed. The objectives of the study were to determine the causes of the erratic profit performance of the industry, to determine the extent of economic improvement required in order for the airlines to finance future equipment needs, and to evaluate potential economic gains from technology advances of recent years.

This report presents the results of the study. The history of U. S. scheduled airline profitability is documented, and operational and economic factors affecting past and future profitability are discussed. The trends in air traffic growth, capacity competition, and route structure are examined in relation to load factor control and profitability. Factors affecting unit operating cost and revenue yield are investigated in order to assess trends in operating profit margin. The future capital requirements of the industry are analyzed to determine required levels of profitability, and the effects of load factor improvement, fare level changes, and technology advances on future industry profitability are investigated.

No attempt was made to examine the profitability of individual carriers. It is recognized that such considerations constitute important parts of the overall airline profitability question. However, the study of individual carrier profitability is of less importance to the objectives of this report that is the industry-wide experience, and would have required a much deeper investigation into the historic processes of the industry.

There was also no attempt to make policy recommendations. However, since an investigation of factors affecting the profitability of the airline industry would be incomplete without some mention of the impact of regulation, there are discussions of past Civil Aeronautics Board (CAB) actions in a historical context. It is not the intent of the author to convey either a pro or con position on any past or future policy issue.

It is important to note that, through route regulation and fare regulation, the CAB influences the profitability of both the industry and individual carriers. Capacity limitation agreements and fare increases have an immediate and strong impact on airline earnings. The effects of route award decisions and load factor standards generally are not realized so quickly, but these and other CAB actions can also have significant impact on industry profitability.

The results of the study indicate that fare levels are not the source of industry financial problems. Specific examples of operating costs in excess of fare levels exist in certain short-haul markets and on routes with low traffic density, and there are numerous highly competitive routes which have been unprofitable due to fare discounting. Overall, however, the average revenue yield has been adequate for a reasonable industry profit performance. The profit erosion of recent years has been due primarily to excess capacity. A permanent return to the load factors experienced in the mid-1960's would be a major step in bringing a return to the prosperity enjoyed by the industry in that period.

The problem of capacity control is an intrinsic characteristic of the industry in the present regulatory environment. As it is a highly regulated industry, the number of competitive modes available to the participants is restricted. Since price competition is very limited, there is intense competition in the remaining competitive modes, such as the quality of service and frequency of flights offered. Furthermore, frequency competition is encouraged by the belief of many airline managers that the airline offering the greatest flight frequency receives a disproportionate share of the traffic on a particular route. While this practice may be only one of many causes of industry-wide overcapacity, it contributes to increases in the cost of operation and reduces industry profitability.

The rapid increase in fuel prices of the past year has added a new dimension to the airline economic situation. Average fuel costs in mid-1974 were about double these of mid-1973, and further increases will occur as expiring fuel contracts are renegotiated at current prices. The annual fuel bill of the U. S. scheduled airline industry is increased by about $100 million for each 1¢/gal. increase in jet fuel price. Thus, future equipment plans must give due attention to fuel conservation. Since fuel consumption increases with aircraft gross weight, added emphasis will be placed on matching equipment size to the capacity requirements of each route. In addition, the need for fuel-conservative aircraft will be an important factor in fleet replacement decisions. There is a clear challenge to the aircraft manufacturing industry to provide the necessary technology for significant reductions in aircraft fuel consumption.

Near-term solutions to the airline financial problems depend upon the course of action by the industry and the CAB, and upon the general economic health of the nation as well. Through a combination of capacity reductions and fare increases, industry profitability in 1974 was much better than that in 1973 despite substantial operating cost increases. However, traffic demand and the cost of fuel and labor are largely beyond the control of airline management, and present indications suggest that 1975 may yield both lower traffic growth and further escalation of operating costs.

For the longer term, the only acceptable alternative to continued fare increases is a reduction in unit operating costs. Historically, this has come through technological advances which have reduced fuel consumption and increased the productivity of airline employees and of aircraft in service. The introduction of jet aircraft in the late 1950's provided large productivity gains as a result of substantial increases in both seat capacity and aircraft speed. The new wide-body jets are larger, but only slightly faster than early jets, and do not represent the same large step in technology that the early jets provided over their predecessors. As a result, the reductions in unit operating cost are due largely to size, and the benefits have not been fully realized because of the inability of the airlines to fill the additional seats.

The next generation of transports is expected to incorporate technologies developed under Government sponsorship in the 1960's and 1970's. Propulsion advances will reduce fuel consumption by about 20% to 30% from early turbofan engines. These new engines will also provide less atmospheric pollution, and may yield noise levels at least 10 epndb below current Federal Aviation Administration requirements. Aerodynamic improvements may provide further reductions of about 15% to 20% in fuel consumption, and commensurate operating cost benefits.

Introduction of other new technologies such as composite materials for airframe structural weight reduction, advanced engines, and new flight control concepts offer potentially significant reductions in fuel consumption and operating cost. Such technologies are not likely to see airline application before 1985, however, because the present lack of operational experience increases the investment risk. Continued research into these and other areas by NASA and the Department of Defense will provide the aviation industry with necessary data on the performance, safety, and economic aspects of these technologies. Long-term goals of the research efforts include fuel consumption levels of one-half those of today's most efficient transports. The operating cost reduction could exceed $2 billion annually, at the traffic rates and fuel prices likely to prevail by the late 1980's.

Since labor constitutes about 40% of airline operating expenses, technology advances which improve employee productivity will have a large economic impact. The output of available seat-miles per employee has doubled in the last decade, saving about $5 billion annually at current labor rates. Further gains are expected from automation of ground services, continued increases in average seat capacity, and improvements in aircraft reliability and service life.

INTRODUCTION

The air transport industry has long been one of the fastest growing segments of the U. S. economy. Revenue passenger miles served annually by the U. S. scheduled airlines have grown from 15 billion in 1952 to over 160 billion today. Although the air travel growth rate has declined as the industry has matured, the Air Transport Association (ATA) has estimated that the U. S. carriers will serve 300 billion revenue passenger miles annually by 1980.(1) The air cargo market is expected to grow by about 16% annually, reaching 20 billion ton miles per year by 1980.

Industries fortunate enough to experience such growth usually are highly profitable. However, this has not been true of the U. S. airlines. Despite tremendous growth in assets and revenue, profitability has been very erratic. Whether expressed as profit margin on sales or as return on total investment, the profit history of the airline industry has been disappointing to investors and lenders alike. The total net profit for the U. S. scheduled airline industry has ranged from a high of $427 million in 1966 to a $200 million loss in 1970. Although the industry has partially recovered from the misfortunes of 1970, the net profit in 1973 was only $225 million, a relatively poor 1.8% of total revenues. Although 1974 provided further improvements in profitability, 1975 is less certain, due to traffic declines experienced in the past several months.

The financial health of the air transport industry is a matter of public concern. Numerous benefits accrue to the public from the air transportation system. Air travel has provided rapid delivery of cargo and mail, and both business and pleasure travelers have benefited by improvements in safety, speed, comfort, and number of points served. Stimulated by a variety of promotional fares, personal travel now approximates business travel and has been the faster growing of the two markets in recent years. Further increases in time and money allocated to leisure activities will make future air travel increasingly attractive if the ratio of air fare to personal disposable income remains favorable.

The capital commitment required to finance the growth in air travel is extraordinary. In the early 1960's the airlines launched a multi-billion dollar re-equipment program which substantially improved air transportation productivity. Through conversion to all-jet fleets, dramatic improvements in service and trip time were realized even while reducing the cost to the traveler. During the 1970's another major re-equipment cycle is occurring, leading to an even larger financial commitment by the airlines as wide-bodied jets are purchased in increasing quantities. In the coming decades there will be a requirement not only for environmentally acceptable aircraft to replace the aging jets of today, but also for technologically advanced aircraft to offset the inflationary impact of rising fuel costs and employee compensation. Estimates of future airline capital requirements vary, but the ATA has concluded that the U. S. scheduled airlines will expend about $20 billion for new flight and ground equipment between 1975 and 1980.[2] The required resources may not be available unless the airline industry profitability improves.

Concern over the future financial viability of the airlines leads one to question the causes of past difficulties. Has the erratic performance of the past been due primarily to natural fluctuations of the U. S. economic cycle? Have allowable fare levels been adequate? What steps can be taken to ensure that past problems are not repeated? In an attempt to answer some of these questions, a study of the financial history of U. S. scheduled airlines has been performed. The study was initiated in March, 1973, at the request of Mr. William M. Magruder, then Special Consultant to the President. The objectives of the study were:

(1) To identify the causes of the poor record of profitability of the airline industry;

(2) To determine if the industry has been subsidizing the traveling public, and if so, to compare prevailing air fares to those required for a more reasonable level of profitability;

(3) To evaluate the extent of economic improvement required for the airlines to finance future equipment needs;

(4) To assess potential economic gains from recent technology advances in the transport industry.

This report presents the findings of the study. The history of U. S. airline profitability is documented, and operational and economic factors affecting past and future profitability are discussed. The effects of traffic growth, capacity competition, and route structure on load factor control and profitability are examined. Trends in unit operating cost, employee productivity, and fare levels are investigated. Future capital requirements and ability of the industry to finance projected aircraft purchases are addressed briefly, and the effect of load factor improvement and new technology upon industry profitability is analyzed.

FINANCIAL HISTORY OF THE U. S. SCHEDULED AIRLINES

Industry Profitability

The U. S. airline industry has experienced tremendous growth since its inception. The compound annual growth rate in revenue passenger miles (RPM) was over 12% from 1946 to 1973. The number of passengers carried nearly tripled during the decade of the 1960's alone. Even during most periods of national economic recession air traffic has shown little or no decline, although growth rates have been reduced. Total operating revenue has continued to increase every year since scheduled service began.

Despite the continuous revenue growth, the profitability of the industry has been erratic. Figure 1 illustrates the profit history of the U. S. scheduled airline industry since 1950. While the decade of the 1950's represented a fairly stable period with industry profits after taxes of about $50 million to $80 million per year, this represented a declining performance in relation to both the sales and investment required to produce that profit. Figure 2 shows that return on investment (ROI) declined from a high of 11.0% in 1951 to 6.2% in 1959; while profit margin on total revenue declined from over 5% in 1951 to 2.7% in 1959. This profit deterioration occurred during a period which saw total revenue increase from $1.1 billion in 1951 to $2.7 billion in 1959.

By 1960 the industry profit was only $9 million, and a $38 million loss was recorded in 1961. There then occured a period of increasing profitability during the mid-1960's as traffic grew by 15% or more per year and the introduction of jets increased aircraft productivity. For the three-year period 1965-1967 the average annual profit was more than $400 million, which was greater than the total industry investment 20 years earlier. Note, however, that while the net profit reached a peak of $427 million in 1966, the investment required to produce that profit had doubled from $2.3 billion in 1960 to $4.6 billion in 1966.

During the late 1960's airline profitability was once again declining, finally yielding a net loss of $200 million in 1970. This trend began in 1967 when most of the aircraft in airline service had been converted to jet and the economics inherent in changing from piston to jet aircraft had largely been realized. Rapid inflation in fuel and labor costs, landing fees, and other expense items contributed to this profit decline.

In 1969, 26 of 39 scheduled carriers had a net loss. Four of the twelve major carriers had a net loss, and all nine local service carriers and all three cargo carriers sustained losses. With a total investment of $8.6 billion and revenues of $8.8 billion, the total net profit of the scheduled airlines was only $53 million.

In 1970 the record was even worse. three of the four largest carriers and a total of seven of the twelve major carriers had losses. Seven of nine regional carriers, and two of the three all-cargo carriers had losses. Of the $200 million total industry loss, $118 million was absorbed by the twelve major carriers. The local service carriers lost a total of $61 million, despite federal subsidies of $59 million.

These periods of poor profitability have affected the ability of the airlines to purchase new equipment and the manner in which that equipment is financed. Figure 3 illustrates the growth of long-term debt and stockholder equity for the scheduled airlines. Prior to 1959 the majority of financing was through equity capital. However, the re-equipment cycle leading to conversion to jet fleets was financed primarily through debt expansion, and by 1961 the debt:equity ratio was an undesirably high 2:1. This high debt:equity ratio, coupled with poor earnings in 1961, made lenders reluctant to further expand airline debt in the early 1960's, and total investment was nearly unchanged from 1961 until early in 1964. Rapid traffic growth in the mid-1960's, coupled with the stable fleet investment, led to rising load factors and greatly increased profitability between 1963 and 1966. The increased profits allowed additional equity financing, and by year-end 1965 the debt:equity ratio was down to 1.17. This improvement in the industry balance sheets, in addition to the rapidly rising traffic demand and airline profitability, led the major lenders to once again expand debt financing of new equipment. By 1970 the debt:equity ratio was back to 1.97 as long-term debt of the scheduled airlines reached $6.1 billion. The 1970 interest on that debt was $318 million, and, as figure 4 shows, interest payments on debt have exceeded airline net profits in all but four years since 1960.

The Civil Aeronautics Board (CAB) in 1972 established a guideline of 12.0% ROI as being a reasonable level of profitability for the industry. Prior to 1972 the ROI guideline was 10.5%. It is apparent from figure 2, however, that the required level of profitability has seldom been reached. In fact, a

10.5% ROI has been achieved in only five of the last 25 years, and 12% has been reached but twice.(3)

Figure 5 shows the annual profit shortfall in terms of the additional after-tax earnings needed to achieve a 10.5% rate of return for the certificated route air carriers. In recent years this shortfall has become immense, reaching $730 million in 1970. Of course, as the investment base has grown larger the absolute magnitude of a 1% ROI shortfall has grown. In 1970 a 1% shift in ROI was equivalent to $80 million in industry profit.

Prior to 1965 the investment base used in calculating the shortfall was total investment, while after 1965 the CAB investment base computation uses an adjusted investment, which excludes equipment purchase deposits. Thus, if total investment were used as a base, the earnings shortfall since 1965 would have been greater than that shown.

Capital Availability

With large earnings shortfalls such as have recently occurred, it is very difficult for the airlines to meet capital requirements for new equipment purchases. Outside capital is difficult to obtain and carries a high interest charge when it is available. Added debt and high interest rates further reduce future earnings and hamper efforts to reach the industry ROI guideline.

A new period of financial stability, on the other hand, would have many beneficial effects on the industry. Not only would internal sources of capital be greatly improved, but lender confidence would also be restored. For example, when the industry has a debt: equity ratio of 1.5, which is a level acceptable to most major lenders, each $1.0 million of profit increase generates a potential $1.5 million of new debt capacity, thereby providing $2.5 million for future equipment needs.

Poor profitability also reduces funds available for new equipment by reducing the investment tax credit (ITC) available to the industry. Although ITC's are legislated only intermittently, they can be an important source of internally generated funds. In order to realize the full tax credit, however, airline profitability must be sufficiently high that federal income taxes incurred by the industry are greater than the total of available ITC and other tax deferrals.

In the late 1960's, a time of economic stress for the airlines, a new and more complicated method of financing new equipment was introduced. As an alternative to straight debt or equity financing, a large amount of external capital was raised through investment tax credit leases. An outside party would buy the aircraft, thereby gaining the benefit of the ITC, and lease the aircraft to the airline. By the end of 1968 air carriers had financed about $1 billion of equipment with ITC leases, and in 1969 about one-half of the new aircraft acquisitions were obtained by lease.[4]

There are two disadvantages of the leasing concept. One is that the long-term cost of financing tends to be high with leasing. The other is that while lease obligations are sometimes regarded as a form of long-term debt, thereby increasing the debt:equity ratio and increasing difficulty of securing other financing, the leases are not recognized as a part of debt in computing ROI. Thus, the maximum allowable profit in good years will be less than if straight debt or equity financing were used in place of lease financing.

Implications for Future Profitability

The poor record of airline profitability described in this section is a matter of public concern. In particular, recent deterioration in both industry profits and financial condition raises the question of the ability of the airlines to finance additional equipment needs for the next decade and to maintain past levels of service. An objective examination of the causes of this poor profit record is therefore warranted. Do the past problems stem from inadequate fare levels, or has inability to control costs been the cause? Can improved profitability be achieved within the current framework of industry operating practice, requiring only a more stable national economic environment? Will advances in aeronautical technology improve airline productivity and reduce fuel consumption enough to offset future inflation in fuel, labor, and other costs? Answers to these questions are sought in the following pages.

FACTORS AFFECTING AIRLINE PROFITABILITY

External Factors

There are numerous factors affecting airline profitability, many of which are not within control of the industry management. External factors such as general economic conditions and actions by the regulatory bodies can have major impact. Examples of external factors which depend largely upon the state of the general economy include: the rate of traffic growth; escalation of fuel costs, interest rates, and employee compensation; the method of financing equipment purchases; and changes in employee productivity. Fare structure and competitive route awards are major factors which are within the regulatory powers of the CAB and over which the airlines exert limited influence. Aircraft landing fees are determined by local authorities, and vary widely from airport to airport. Only in the quantity of equipment purchased, frequency of flights offered, and level of service provided do the airline managers have decisive control over their own profitability. Of these three factors, the first must be decided several years in advance of actual equipment needs because of the long lead time in aircraft development and construction, and the other two are often decided by competitors' actions. The absence of a significant amount of price competition within the scheduled airline industry leads to extensive competition in schedule frequency and quality of service, both of which increase operating expenses. The extent to which these additional expenditures are effective in increasing load factor and revenue, of course, determines the success of the individual airline management in increasing profitability.

Route Structure

Of the many factors affecting the relative profitability of individual airlines, route structure is of prime importance because it affects both revenue and cost of service in numerous ways. The average stage length, the traffic density, and the number of competitors are route-related factors which can mean wide variations in individual carrier profitability regardless of the general state of the industry. These factors can directly impact profitability through load factor, average revenue yield, and unit operating expense. They can also impact profits indirectly, by affecting management flexibility to respond to the external factors discussed above.

Average stage length can affect profitability because the margin between revenue and operating expenses usually increases with trip distance. This is partially due to the better ratio of revenue to fixed costs (ticketing, passenger boarding, landing fees, etc.) on long trips. In addition, the CAB policy on fare structure has in the past resulted in greater profitability on longer stage lengths. This policy has been to allow cross-subsidization of carrier losses on short-haul service by greater profits on longer routes.(5) That is, the allowable fare on flight segments under 300 miles generally has not fully covered the cost of providing the service. However, the allowable fare on longer stage lengths, where traffic is not as sensitive to level of fares, was purposely made sufficiently high to yield an adequate overall level of profitability to the airline industry. This policy could have considerable impact upon profit distribution within the industry, since travelers going less than 300 miles account for 82% of all local service airline passengers and 34% of all trunkline traffic.(5)

The CAB based this policy on the assumption that any fare structure which increased the cost of short-haul service would drive these travelers to alternative forms of transportation, adversely affecting the carriers and being detrimental to public service. Losses suffered by local service carriers due to air service provided in the interest of public convenience are at least partially reimbursed through federal subsidy. However, trunk airlines must offset these losses with profits on other routes.

Future changes in the fare structure seem assured as a result of the new rate policy announced by the CAB in March 1974. The new policy establishes cost as a determining factor in setting rates, and will to some extent eliminate the cross-subsidization concept. Future fare increases on short-haul routes may therefore be greater than those on longer stage lengths. One expected result of this policy is a shift of some revenues from the long-haul carriers to the short-haul carriers, but the net revenue changes will depend upon the price elasticities in both markets. The ultimate effect on profit distirbution remains to be seen.

Traffic density and number of carriers serving a route are very important to profitability since they determine the aircraft size required, the frequency of flights, and the degree of competition for market share. These factors affect revenue through load factor and sometimes through competitive fare discounts.

Unit operating cost is affected both by service competition and flight frequency. Employee productivity is also affected by traffic density. For example, it is usually possible to obtain a better ratio of number of passengers to number of employees on high density routes, since there is a minimum number of flight and ground crew required regardless of the number of passengers.

Load factor is an important determinant of the ratio of revenue to operating costs, and the carriers compete vigorously for a large share of the total market in order to achieve high load factors on given routes. Generally a carrier can achieve better profitability on a monopoly route, since schedule frequency can be established with the objective being a satisfactory load factor rather than an attempt to increase market share. Figure 6, reproduced from reference 4, illustrates that for one carrier, 35% of the profit in one year was gained on monopoly routes yielding only 9% of the total revenue. Another 50% of the total profit was achieved on routes yielding only 20% of the total revenue, leaving 61% of the routes (in terms of total company revenue) which provided little contribution to profits. This situation, which is typical of the industry, leads to intense competition for access to the more profitable markets, and often results in excessive capacity being offered in the name of public service. For example, in 1969 the number of carriers serving the then-lucrative mainland-Hawaii market was increased from three to seven. This circumstance changed that market from a highly profitable one to one where large losses were sustained by some, if not all, of the carriers. In the following year one carrier suffered a revenue diversion of $73 million and sustained a profit reduction of $25 million due to market share reduction on its Hawaii routes.(4)

Operating Factors

Factors affecting the profitability of individual routes or individual airlines are of interest because they are signficant to the profitability of the industry as a whole, because they explain much of the seemingly destructive competition introduced by the airlines, and because they are an important part of the background information which the CAB must consider in making route awards. However, the guidelines used by the CAB in most regulatory matters are not the profitability of an individual airline, but the profitability of the airlines as a group.(5) It is on this basis that fare levels are set and route awards are made, and it is this broader issue of total industry profitability which is of interest to the present study.

Ignoring for the present the factors affecting non-operating profits, such as interest on debt, income taxes, and investment tax credits, there are four major factors which determine industry operating income. These are total traffic and revenue yield, and total capacity and unit operating cost. The first two determine total airline revenue, while the product of the second two determines total operating expenses. The relationship of these four factors and the causes of changing trends are explored in detail below.

Traffic Growth

Traffic growth in the air transportation industry has been impressive. From 1945 to 1972 the compound annual growth in revenue passenger miles (RPM) was 14.6%. The growth rate has slowed somewhat as the industry has matured, declining from an average of 21.8% per year in 1945-1950, and 14.3% per year in 1951-1960, to 13.0% per year in the 1961-1970 period. Future growth rates will probably continue to moderate.

Air passenger traffic has been somewhat recession-resistant,often experiencing only reduced growth rates rather than contractions during periods of national economic stress. However, figure 7 shows that the industry has sometimes been quite cyclical. The two periods from 1949 to 1957 and from 1962 to 1968 both yielded average compound annual RPM growth rates of over 16%, while the two periods from 1958 to 1961 and from 1969 to 1971 provided average growth rates of only about 6% per year. Indications of traffic decline in late 1974 and early 1975 suggest that, as a maturing industry, the airlines may be even more sensitive to the buiness cycle in the future.

Reduction in traffic growth has a severe effect on load factor, since capacity growth is usually determined by new equipment orders placed several years in advance. For example, from the time that the first airline orders were placed for the Boeing 747 in mid-1966, until the first 747 entered airline service in January 1970, passenger load factor had dropped from 58% to 50%. The introduction of the 747, coupled with a very modest traffic growth, had further reduced industry load factors to 48.5% by the end of 1971. The poor load factors of the early 1970's would appear even worse except that the wide-body jets have been operated at less than maximum seating configurations due to the use of lounges and generous seat spacing.

Much of the growth of air traffic has been due to pleasure travel. In 1972, 54% of the passengers of one major airline were pleasure travelers, compared to 45% in 1960. If this relationship was typical of the entire scheduled airline industry, then pleasure travelers grew in number from a total of 28 million in 1960 to 103 million in 1972, while business travel grew from 34 million passengers in 1960 to 88 million in 1972, only about two-thirds as fast.

The trend toward an increasing percentage of pleasure travel has had both a good and bad effect on airline profitability. While the increased traffic has increased the total revenue and profit potential, the fare yield is lower for pleasure travel, and the traffic pattern is much more seasonal than that of business travel. Wide variations occur in monthly load factors, and hence in airline revenue, although the costs of providing air service are largely determined by the number of employees and aircraft required to satisfy peak travel demands. Airline economic efficiency would be improved by a reduction in the hourly, daily, and monthly demand variations.

Although the matter of price elasticity has proved very elusive in past studies of air travel demand, it is generally conceded that pleasure travel is more sensitive to price than business travel. Thus, much of the growth in pleasure travel may have been a result of the various promotional fares introduced in the 1960's. While it is too early to discern the effect of the 1973 CAB order to phase out many promotional fares in 1974, it is likely that future growth in pleasure travel will be reduced somewhat by this action.

Air cargo traffic has grown somewhat faster than passenger traffic, and has recently accounted for about 24% of total ton-miles carried by U. S. scheduled airlines. (1) The fraction of revenue coming from cargo traffic has remained fairly constant at about 13% of total industry operating revenue since before 1960. The growth of cargo traffic was subject to the same business cycle conditions that reduced passenger and traffic growth in the late 1960's. From 1969 to 1971 the average annual growth rate was 7% compared to a rate of 21% between 1961 and 1968. This slowdown would have been more severe without tremendous growth in international operations of the all-cargo carriers between 1969 and 1971.

Traffic Forecasting

The effect on revenue and profits of changing passenger and cargo traffic growth rate is enormous. The ATA has estimated that 1970 airline revenues were about $1.25 billion less than they would have been if traffic growth had continued at 1963-1968 levels.(6) A significant portion of this additional revenue would have been translated into pre-tax profits since many of the operating costs are fixed.

While the airlines have limited control over traffic growth, the extreme sensitivity of profits to load factor suggests the need for good traffic forecasting and a flexible approach to capacity control. Traffic forecasting methods can range from simple trend extrapolation to sophisticated econometric models. Forecasting is an inexact science, however, and hindsight shows that the airlines, the aircraft manufacturers, and the regulatory agencies all failed to predict the traffic slowdown which so seriously affected industry profits between 1969 and 1971. Moreover, the airlines were slow to adjust capacity to provide a better balance with traffic growth rates. While a host of reasons, competitive, legal, and financial, can be sited for this failure, the fact remains that better load factor control must be achieved in the future.

Capacity Growth

The profitability factor over which airline management has most control is available capacity. Unfortunately, the record shows that it has proven very difficult to keep capacity growth in line with the rate of growth in air traffic. It was noted earlier that the reduced traffic growth rates between 1969 and 1971 had a very adverse effect on load factor. However, load factor deterioration had actually begun in 1967, even while traffic was growing faster than at any time since 1951. In 1967 the available seat-miles (ASM) offered by the scheduled airlines increased by 26.9% over 1966, while revenue passenger miles grew by 23.6%. Another 23.8% increase in available seat-mile capacity was provided in 1968, and capacity increases continued to outstrip traffic gains in every succeeding year until 1972. Figure 8 compares annual growth rates in RPM and ASM from 1960 to 1973. Figure

9 illustrates the declines in passenger load factor and overall ton-mile load factor, and the trend in overall load factor required for breakeven operation.

Causes of the poor load factor control are numerous: volatility of market demand; the long lead time for new equipment purchases; the necessity to add capacity in rather large increments; and the use of frequency as a major competitive tool in seeking increased market share. The volatility of traffic growth has already been discussed in some detail, and is, of course, largely beyond the control of the industry. The second and third factors are common to many industries, and can only partially explain the erratic profit performance of the airlines. The competitive factor, however, is a significant cause of past instabilities in both load factor and profits.

The problems of long lead time and incremental capacity addition have historically resulted in capacity growth which first leads and then lags traffic growth. Rapid traffic growth, high utilization of flight equipment, and rapid advances in technology have contributed to a new re-equipment cycle every 10 to 15 years. The new equipment must be ordered in fairly large quantities before the aircraft manufacturer is reasonably secure in proceeding with the very risky and expensive development program. Also, the aircraft have traditionally been larger than the previous generation, in order to accommodate future traffic growth and assure that the aircraft size will be adequate for the majority of its depreciable lifetime. This usually means that the aircraft are too large for the market when first delivered, as has been the case with the wide-body jets. The combination of simultaneous introduction of large numbers of new aircraft and increased size of individual aircraft has made load factor control very difficult to achieve. This problem is compounded by the difficulty in providing only a small capacity increase to accommodate normal annual traffic growth on an individual route. An airline must add capacity in complete plane-loads, which may result in a much greater capacity addition than is justified by the traffic growth.

Frequency Competition

The problem of matching capacity to traffic growth has contributed to an inability to maintain a consistent margin between actual load factor and the load factor required for breakeven operation. Also important, however, is the degree to which frequency competition is relied upon in the airline industry. As members of a regulated industry with limited price competition, the airlines have resorted to using increased flight frequencies to gain increased market share. For example, the large capacity increases in 1967 and 1968 are probably more due to competitive factors than to any other reason. Encouraged by the good growth in traffic and profits of the mid-1960's, the airlines began a vigorous competitive battle for a larger share of the growing market. Capacity was increased through investments in new flight equipment of $5.2 billion in 1967, and an additional $6.5 billion in 1968. The number of aircraft departures increased by 580,000 in 1967, an increase of 13% over 1966, and another 400,000 new departures were added in 1968. The result of these capacity increases was that passenger load factors dropped from 56.6% in 1967 to 51.1% in 1969. Industry operating expenses grew by 36% from 1967 to 1969, while operating revenues increased by only 28%. This two-year change reduced industry operating profit by 45%, and industry net after tax profit decreased by 87%.

Why does an airline management not reduce capacity by grounding aircraft in times of low load factor? In answer, the Chairman of the Board of one large U. S. airline has stated: "Adding frequency creates a great competitive advantage, hence all competitors are induced to seek this advantage. Unless an airline wants to go out of business, it must add capacity to prevent other carriers from gaining the advantage over it. Thus, there is no natural economic inducement to restrain capacity as traffic grows. And when volume drops, a unilateral reduction in capacity can be economic suicide. If you examine the performance of the trunk carriers over the past five years, you will see that the carriers that increased capacity the greatest had the highest earnings. The carriers that were the most restrained had the lowest earnings."(7)

This view is widely held throughout the industry and is largely responsible for the persistent downward pressure on industry load factor. The view is based in part on the S-curve relationship between market share and frequency share shown in figure 10.(8) This relationship has been observed by a number of airline analysts, and is possibly a result of the fact that travelers often contact the dominant carrier on a route first, expecting to find greatest flight frequency and hence departure times closest to those desired. According to the S-curve theory, the carrier offering fewest seats will achieve a disproportionately low share of the passengers flown. For example, on a two-carrier route, a carrier offering 30% of the total available seats would typically capture about 20% of the market. Since a passenger load factor of about 50% is required for breakeven operation, this carrier would lose money on that route unless the overall route load factor is 75%, a figure seldom achieved. The alternative to operating at an unprofitable load factor is for the minority carrier to attempt to capture a greater market share by increasing flight frequency.

The S-curve theory is not universally accepted. It has been suggested that the phenomenon may exist only in particular types of markets, such as high density routes with pronounced traffic peaking characteristics. Other factors, such as the limitations on price competition, may be more significant causes of frequency competition and overcapacity. However, the acceptance of the S-curve theory by some airlines seems enough to assure competitive actions contributing to the problem of overcapacity and reduced profitablity.

On an industry-wide level this type of competition can be very destructive. When one carrier places an order for additional equipment, others may do likewise because it is not known which routes will receive the new equipment. Carriers thus sometimes buy new equipment more from a desire to increase or maintain market share than from a requirement to meet traffic demand. This results in equipment orders coming in clusters, particularly if the equipment represents an advance in technology with wide market appeal, as did the wide-body jets. While the near-term result is reduced profitability due to overcapacity, the carriers hope that long-term profitability will be enhanced as traffic grows and market share is improved.

Fare Policy and Competition

Recent changes in CAB policy may reduce future capacity competition within the industry. Concern over load factors led the CAB to establish load factor standards for rate-setting purposes in April 1971, for the first time. An interim standard of 52.5% was used in setting a 9% domestic fare increase for 1971, but a 55% trunkline load factor and a 44.4% local service carrier load factor were established as reasonable standards for future rate setting purposes.(9) The local service carrier load factor standard was later vacated by the CAB.

Load factor standards are not intended to eliminate airline management discretion to make needed capacity adjustments, but rather to prevent the airlines from seeking fare increases to recover the cost of excess capacity. This action may benefit both the public and the airlines in the long run, as it will encourage better load factor control, which will reduce fuel consumption and airport congestion, achieve a better balance between airline revenue and operating costs, and reduce upward pressure on fare levels.

Capacity Limitation Agreements

Another CAB action which influences airline profits is the granting of permission to the airlines for discussions leading to capacity limitation agreements. Unlike load factor standards for rate setting, whose beneficial effects will not be realized in the near term, capacity limitations have an immediate effect on the profitability of the airlines involved by providing substantial reductions in operating costs.

In the first such agreement, which began in October 1971, three carriers realized average load factor increases from 38% to 54% on four transcontinental routes in the first year of the agreement. This was sufficient to change these routes from unprofitable to profitable operations. A two-year extension of the agreement is expected to further increase load factors to 60-65% year round, saving an additional $80 million in combined operating costs.(10) In October, 1973, capacity limitation discussions were extended to include about 30 scheduled and supplemental airlines serving the entire domestic market. Although this action was in response to the jet fuel shortage, it was also highly beneficial to load factors.

Capacity limitation agreements are an effective temporary means of reducing present industry overcapacity problems created by equipment orders placed before the current CAB load factor guidelines were established. However, the entire issue is very complex, particularly in regard to application on routes served by both large and small airlines. Widely divergent views have been expressed by various carriers and government agencies regarding the merits of such agreements, with some sentiments expressed that the longer term interests of the airline industry and the traveling public may be best served by free-market competition. The

Initial Decision of the Administrative Law Judge in the Capacity Reduction Agreements Case, CAB Docket 22908, to disapprove the agreements at issue is currently pending before the Board on review.

Revenue Yield

While airline profits are influenced by route regulation, the effect of fare regulation is also high. Although the CAB in the past has used route competition primarily to reduce industry profits (as in mid-1960's) when ROI exceeds the legal maximum, fare regulation has been used primarily to increase yield in times of low profitability.(3,4) There have been exceptions to this policy, including not only the recent capacity limitation agreements designed to increase industry profitability, but also times when fare levels were reduced. Generally, however, fare policy has favored increases which attempt to bolster revenue in response to escalations in unit operating cost. The impact is large because the effect of increased fare level is felt immediately in operating profit.

Figure 11 shows that the average revenue yield per passenger-mile realized by the U. S. airlines has fluctuated from year to year but in 1972 was at basically the same level as that of the early 1950's. This has occurred despite the periodic fare increases authorized by the CAB. The erosion of yield in relation to fare is partly due to a variety of special discount fares used as promotional devices, and partly due to the continuing increases in the percentage of passengers traveling economy class shown in figure 12.

Promotional Fares

The concept of separate first class and coach service as opposed to single class service was first introduced in 1948, as was the family plan concept, where additional family members were allowed to travel at half price with one full-fare passenger. Through the years military discounts, youth standby fares, group travel plans, and various excursion fares have been introduced in an attempt to increase load factors. These plans have appealed primarily to the pleasure traveler, and have no doubt been a factor in the rapid growth of that market.

Promotional fares have appeal to the airlines for several reasons. They attract new travelers who otherwise may not have flown, and induce people to fly more frequently. They are also a useful competitive tool to gain an increased market share for a particular airline. Thus, while some revenue may be lost in the short term due to a diversion of passengers from full fare to part fare, it is expected that many of the new passengers will become frequent customers, thereby providing a long-term gain.

There is a strong possibility that the yield erosion which occurs through promotional fares is fully offset by the increased revenue due to load factor gains. The aircraft operating costs (fuel, flight crew expenses, aircraft maintenance, and depreciation and insurance), which constitute about one-half of total operating expenses, are fixed for a particular flight. The remaining operating expenses, which include promotion and sales, traffic service and landing fees, and passenger service, are only partly related to load factor. It has been claimed that the marginal cost of adding an extra passenger to a flight amounts to only 10% of the fare paid by the passenger, with the remaining 90% contributing directly to operating profit.(4) Of course, this would be true only if the number of extra passengers were not sufficient to require an equipment change to a larger and more expensive airplane.

The strong relationship between load factor and profits does much to explain the vigorous airline competition for market share. It also provides strong incentive for the use of promotional discount fares such as family plans, which encourage a business traveler to take the entire family on trips, or group travel plans, which led to the present low-price charter concept.

Promotional fares have periodically been modified or eliminated in an attempt to increase revenue. They have also been used selectively to encourage international or domestic travel. Consequently the yield in a given market has changed with time and in a different manner for different markets. In 1959 the revenue passenger yield for international flights was higher than the yield on domestic flights, both in first class and coach. In 1961 this was still true, but a higher percentage of economy class passengers in international travel had reduced the average yield below that achieved in domestic travel. Changes continued throughout the 1960's and by 1970 the domestic yield was higher than international yield in both first class and coach. Excess capacity and a proliferation of discount fares to meet competition from charter operations and government-subsidized foreign airlines have led to this yield erosion.

These factors have been especially significant in reducing profitabilty in transatlantic operations. A decade ago, the profits from the North Atlantic financed a worldwide network for European and U. S. carriers. Now the situation is reversed. North Atlantic operations have become the source of substantial losses for most shceduled carriers serving that market. For example, one U. S. carrier lost $29.6 million on its North Atlantic routes in 1970, and an additional $35.6 million in 1971.(7) The International Air Transport Association has estimated that the scheduled airlines of the world could lose $1 billion on the North Atlantic in the next five years unless yield is improved.

An indication of how much yield improvement is needed to make North Atlantic operation profitable is given by figure 13.(11) Although this data includes foreign carrier operations, it is indicative of the competitive situation facing U. S. airlines on the Atlantic. Despite first class fare increases totaling 15% over 7 years, and similar economy fare increases, promotional fares reduced the average yield by 16% from 5.44¢/passenger-mile in 1965 to 4.55¢/passenger-mile in 1972. In this same time the average operating cost increased from 5.68¢/passenger-mile to 5.92¢/passenger-mile, leaving a 1.37¢/ passenger-mile revenue shortfall.

Considerable attention has recently been given to this problem by U. S. and foreign airlines, and by the CAB. New policy guidelines for transatlantic charter rates have been considered by the CAB, and the scheduled airlines flying the North Atlantic have agreed to a 10% fare increase, effective November 1, 1974. This was the fifth general fare increase for transatlantic flights in 1974, raising average fares 35% above the 1973 year-end levels.

Yield Trends

Figure 11 shows a steady yield erosion from 1962 to 1968. There have recently been a series of fare increases starting with two in 1969. which increased the average yield realized by the U. S. scheduled airlines from a low of 5.46¢/revenue passenger-mile in 1968 to 6.10¢ in 1972. With further increases to offset the rising cost of fuel, the average yield for the first six months of 1974 was 7.06¢/revenue passenger-mile.(12)

Airline yield may continue to improve in the near future. Figure 12 indicates that the yield erosion due to diversion of traffic from first class to coach appears to have declined as coach traffic has stabilized at about 84%. Further yield erosion due to promotional fares was temporarily halted by the termination of youth and family fare discounts in June 1974, although new discount fares are now being instituted in an attempt to reverse the air traffic declines of recent months. However, it does not appear that the number of passengers flying on discount fares will approach the 43% estimated for 1971. (13) Finally, increases in transatlantic fares will improve yield in this market. Since international travel accounts for slightly more than 20% of total revenue passenger miles flown by U. S. scheduled airlines, increased yield in this market will improve total industry revenue and profitability.

Unit Operating Cost

One of the major factors in the airline industry's poor profit performance in the last few years has been rapid increases in unit operating cost. For the four-year period, 1967-1971, the industry experienced an average annual inflation rate of 5% in operating cost per revenue ton-mile. This compares quite unfavorably with the revenue yield increase of slightly less than 2% per year in the same period. Although 1972 saw little change in unit operating cost, the uptrend resumed in 1973 and accelerated in 1974.

The most important cause of the cost escalation prior to 1974 was airline wage increases, coupled with declining productivity increases. Airline wage rates are among the highest in private industry, and have continued to increase at a high rate. The average employment cost per employee rose 69% from 1967 to 1973.(14) Labor costs as a percentage of total operating expense declined during the introduction of jets, falling from 46.2% in 1958 to 42.6% in 1963, but by 1970 the ratio was back to 45.6%.

Figure 14, reproduced from reference 15, shows that while employment cost per employee was rising at a rapid rate in the late 1960's, annual productivity increases dropped sharply. The result was a dramatic change in the trend of labor cost per revenue ton-mile. The opposite was true in the early 1960's, when annual employee productivity increases of about 10% exceeded the 4% to 5% annual wage increases. This was a result of both the rapid traffic growth in that period and the aircraft productivity increases provided by the introduction of jet aircraft. By 1968, however, the jet conversion was largely complete, and a declining traffic growth rate reduced the annual increase in revenue ton-miles per emplyee to 2% or 3%.[15] This, in combination with the much more inflationary wage settlements which began in 1967, reversed the declining trend in employment cost per revenue ton-mile.

In view of the high percentage of total costs which are labor-related, control of the unit labor cost is an essential condition of adequate profitability for the industry. A return to better traffic growth rates would do much to improve this picture, by increasing employee productivity.

Other elements of operating cost besides labor have also been increasing. Fuel cost increases have until recently been largely offset by improved fuel economy of current engines, so that the fuel cost per flight hour was about the same in 1969 as in 1960. Recent fuel price increases have changed this trend, however. New fuel contracts signed in late 1973 contained price increases ranging from 25% to 100%, with open-ended price escalation clauses.[16] The industry fuel bill may have doubled in 1974, adding about $1.2 billion to operating expenses. With a total consumption of 10 billion gallons of jet fuel per year, the U. S. airline industry will experience a $100 million cost increase for every additional 1¢/gallon increase in fuel price.

Airport facility costs and aircraft landing fees are also contributors to the inflationary trend. Figure 16, from reference 17, compares the growth in landing fees to the growth in the number of annual landings. The cost per landing more than tripled between 1962 and 1971 although the average aircraft size, measured by available seats per aircraft, increased by only 50% during this period. The ATA expects the cost of landing fees and airport rentals to continue increasing by about 8% per year for the near future.[18]

The unit cost due to depreciation of flight equipment has also increased since 1968. This is primarily due to a decline in the daily utilization of the aircraft, as figure 16 shows. The recent capacity limitation agreements will compound this effect because many aircraft will be grounded or flown fewer hours per day. Depreciation costs continue to accrue whether the aircraft is flying or not.

Two factors are likely to reduce the contribution of depreciation charges to unit operating cost in the future. First, average utilization rates can be expected to gradually improve as future traffic growth eliminates the over-capacity problem which currently exists. Second, there is a current trend toward longer depreciation life for new equipment. The CAB has increased the assigned useful life of the Boeing 747 from 14 to 16 years to match that specified for the DC-10 and L-1011. One carrier has increased the depreciable lifetime of its 727 aircraft from 13 to 17 years. The depreciation period for other new aircraft may also be increased in the future.

Profit Margin

The effect of past changes in productivity on the operating profit margin can be seen in figure 17. As jet introduction increased airline productivity, the unit operating cost dropped from 30¢ per available ton-mile in 1959 to a low of 19.5¢/ATM in 1968. Moreover, since traffic was growing faster than capacity during this period, the operating cost per revenue ton-mile dropped even more rapidly.

Although some of these economies were passed on to the airline customers through a declining revenue yield, operating profit margins increased from a low of 0.4¢ per revenue ton-mile in 1961 to a high of 6.8¢/RTM in 1965. Then began a period of declining margins. The rapid escalation of expenses, beginning in 1967, and reduced productivity, beginning in 1968, combined to increase the operating cost per revenue ton-mile between 1967 and 1971. Although revenue yield was improved by several fare increases starting in 1969, the industry operating profit margin had narrowed to 0.2¢/RTM by 1970, and was only 2.4¢/RTM in 1973.

Close examination of figure 17 shows that the declining profit margin in the late 1960's was due more to the overcapacity problem than to inadequate yields. While operating cost increased from 39.3¢/RTM in 1967 to 46.5¢/RTM in 1971, the cost per available ton-mile remained nearly unchanged. Thus, the introduction of stretched jets and early wide bodies continued to increase potential aircraft productivity by an amount sufficient to offset inflationary cost increases. The sharp divergence in trend between cost per RTM and cost per ATM was simply a reflection of declining load factors and overcapacity.

REQUIREMENTS FOR IMPROVED PROFITABILITY

Future Capital Requirements

The capital requirements for the U. S. scheduled air transportation industry have been estimated by the ATA to be $4.4 billion for the period 1973 to 1975, and $20.4 billion for the period 1976 to 1980.[2] These estimates are based on projected average annual growth rates of 16.2% in domestic and international cargo and 9.3% in revenue passenger miles. Equipment requirements were computed using load factors of 57.5% and 50%, respectively, for passenger and cargo traffic.

The traffic growth rates assumed by the ATA are less than average growth rates experienced in the past, but are in reasonable agreement with other recent estimates.[19,20,21] The ATA estimate of the capital requirements through 1980 includes the purchase of 661 new aircraft to provide a net capacity increase of 62% from the 1972 level. A similar estimate of potential capital requirements through 1980 has resulted from an analysis by First National City Bank, a major financier of airline equipment purchases.[19] This indicated a requirement for $25 billion for the purchase of 680 aircraft and ground equipment by the U. S. trunk carriers and Pan American. Of this mount, $20 billion was assumed to be available from internal sources, with the balance of $5 billion to be raised by external financing.

The actual capital requirements of the scheduled airlines will depend on many interrelated factors. Considering the past difficulty of maintaining high load factors in the face of stiff competition, the load factor assumptions of the ATA may prove optimistic. More aircraft than are needed may again be purchased. Moreover, the cost of aircraft modifications to satisfy future environmental restrictions has not been included in the ATA estimate. On the other hand, since both the CAB and the airline industry recognize the economic consequences of the low load factors, there is sure to be a strong effort to improve future load factors. Failure to keep load factors close to the 55% used by the CAB for rate-setting purposes will penalize profits and increase the difficulty of obtaining needed capital.

Even the lower (ATA) estimate of capital requirements will be very difficult to achieve without substantial profit improvement for the industry. Since airline debt positions are already very high in relation to equity. significant expansion of the debt:equity ratio is unlikely. If it is assumed that internal sources of cash are to comprise about 50% of the capital requirement, at least $10.2 billion will be required in the period 1976 to 1980. Of this, about $7 billion may be raised by depreciation of equipment. This leaves $3 billion, or an average of $600 million per year, to be generated from profit after taxes and after dividends to stockholders.

Future Profit Analysis

Figure 18 indicates the operating profit margin required to achieve this level of profitability in 1976. If 10% of the net profit is distributed to stockholders as dividends, the $600 million capital generation requires an after-tax profit of $666 million. This is equivalent to a 9% return to the projected 1976 investment of $11.6 billion for the U. S. scheduled airlines, and requires an operating profit margin (before taxes and interest) of 5.1¢/revenue ton-mile.

Also shown, for comparison, is the actual experience of the industry during the past ten years. Note that a 5¢/RTM operating profit margin has not been approached since 1967. A continuation of the 4% to 6% ROI experienced in recent years will leave the airlines far short of the profits needed to finance future equipment purchases. In contrast, a net profit of about $1.0 billion would result if the ROI guideline of 12% were achieved.

The profit analysis shown in figure 18 was based on a 48% income tax rate, no investment tax credit, and 1972/1973 values of debt:equity ratio, average interest rates, and investment cost per available ton-mile. While future changes in these parameters would alter the net profit slightly, the conclusions regarding profit margin requirements would remain unchanged.

Load Factor Improvement

What will be required of the airline industry and the CAB in order to achieve the needed improvement in operating profit margin? Figure 19 provides a partial answer to this question. Here, operating profit margin is shown as a function of overall ton-mile load factor, with the actual industry experience for the 12 months ended June 30, 1973, shown by the asterisk. The curve represents the expected improvement in margin as load factor is increased from the relatively low value of 46% experienced in the 1972/1973 period. This improvement rate assumes that 90% of the additional revenue generated by increased load factor passes through to operating profit, and that the revenue yield per additional ton-mile is equal to the average revenue per ton-mile.

Actual profit margins and load factors experienced by the industry since 1963 are shown for comparison. These data appear to substantiate the slope of the curve, and also to indicate that the primary cause of the recent erosion in profit margin is the load factor decay brought about by excess capacity. While revenue yield per ton-mile declined continuously through 1968 due to increased use of low-yield promotional fares and diversion of full-fare passengers from first class to economy class, so too did productivity increases provide a unit cost decline in each year prior to 1968. The first year to see inflationary cost increases outstrip productivity increases since introduction of jet aircraft was 1968, and this was followed in 1969 by the first of several general fare increases.

It is clear from figure 19 that a major requirement for improving future airline profitability is maintenance of load factors approaching the levels of the mid-1960's. To this end the airline managers must exercise caution in equipment purchases and in application for new routes. At the same time, however, it is important to ensure that as future load factors increase, profit margins retrace the curve of figure 19. As wide-body jets become a larger factor in fleet composition, and as traffic growth allows these aircraft to be configured with higher seating densities than is now in practice, further productivity gains are likely. This should offset at least part of the expected inflation in fuel costs, salaries, and landing fees. However, periodic fare increases may be necessary to compensate for unit cost increases in excess of productivity gains.

Fare Level Requirements

Figure 20 illustrates the effect of a 4% increase in either fare level or unit operating expense on the 1976 profit analysis. The solid line reflects the impact of load factor on operating profit margin noted in figure

20, based on the unit cost and revenue yield experienced by the industry in 1972/73. The dashed lines show the sensitivity to a 2.0¢/RTM change in profit margin. Ignoring potential price elasticity effects, the upper line may be achieved either by a general fare increase 4% larger than operating cost inflation, by reduced use of promotional fares, or by lower unit costs accomplished through increased productivity. The lower line represents the effect of inflationary operating cost increases uncompensated by fare increases, or erosion of revenue yields through competitive discounting.

The impact of a change of this magnitude is striking; a 2.0¢/RTM variation in operating margin would change 1976 ROI by about 3 counts, and after-tax profit by nearly $400 million. Such changes are not without precedent. Figure 19 shows that between 1965 and 1967 the operating margin decreased by 2.3¢/RTM, although load factor remained nearly unchanged. Conversely, in 1964 the margin increased by 1.8¢/RTM, again with constant load factor.

The previous analysis has shown that for the industry to achieve reasonable levels of profitability in the years ahead, substantial load factor improvement will be required. If the operating profit margin improvement indicated in figure 19 can be achieved, a net profit of about $800 million would result in the 1976 time period from a 50% overall load factor. Since this load factor corresponds roughly to the 55% passenger load factor standard designated by the CAB for future rate-setting purposes, it is the minimum for which the airlines must strive. If, however, the load factor goal is reached but the operating profit margin falls 1.5 to 2.0¢/RTM short of the projected improvement curve, as it did during the period from 1966 through 1970, the industry profit will be $300 to $400 million less.

With continued inflation of the cost of fuel, labor, and other expenses, it will be difficult to prevent erosion of the operating profit margin without further fare increases or productivity gains. Airline industry sources estimate that the price of jet fuel will continue to increase as expiring fuel contracts are renegotiated at current prices. A 25% increase in 1975 and 1976 would reduce the profit margin by about 2.5¢/RTM each year. A 6% annual escalation of landing fees and labor costs would reduce the profit margin by another 1.5¢/RTM.

TECHNOLOGY AND AIRLINE ECONOMICS

The economic dilemma of the airline industry has attracted the attention of numerous public and private bodies. Many corrective measures have been proposed or implemented, including fare increases, government subsidies, route exchanges, mergers, and capacity limitation agreements. Since most of the proposed measures are anti-competitive or result in either higher cost to the traveler or a reduction in service, considerable opposition is raised by consumer groups, government agencies, or competing airlines. Some of these proposals are also short term in nature, addressing the immediate concerns but failing to provide lasting solutions to the airline problems. While the exact course of inflation is not predictable, continued long term increases can be expected in the cost of fuel, labor, and other resources. The inevitable result will be further upward pressure on the price of air travel unless productivity gains and cost reduction methods are effected.

History has shown that such improvements are available primarily through advances in technology. Figure 21 shows that each generation of transports has roughly doubled the productivity of its predecessor, through increases in size and speed. The Douglas DC-3, in 1935, made obsolete every other commercial transport then operating because it pioneered a number of new technologies. It had two powerful, reliable engines and more efficient propellors. It used retractable landing gear and other improvements to lower the drag in flight and allow increased speed. It used new high-strength aluminum alloys to improve the structural efficiency. Each of these individual technologies represented a little breakthrough in aeronautical progress, but the synergistic effect provided a major advance in aircraft performance.

Similarly, jet transports, beginning with the Boeing 707 in 1958, revolutionized air travel by providing substantial increases in size, speed, and passenger appeal. Improvements in productivity, performance, and aircraft reliability provided direct operating cost reductions of nearly 50% from the most efficient propellor aircraft then in service. Reductions in travel cost and trip time, increased safety, and improved passenger amenities and ride comfort resulted in greatly increased air travel demand and the creation of the airline industry as it exists today.

The versatility, performance, and reliability of jet aircraft were made possible by advances in aeronautical technology during the 1940's. Flight safety and schedule reliability were aided by the development of instrument landing systems in 1941, ground-based weather radar in 1948, and navigation radar in 1949. The useful life and structural efficiency of airframes and engines were improved by development of lightweight high-strength aluminum, and by materials such as titanium, by introduction of improved fabrication methods, and by techniques for extending the structural fatigue life. Aerodynamic performance was increased by the development of the swept wing, in 1945, resulting in reduced engine power requirements for high speed flight. The breakthrough of greatest significance, however, was the turbojet engine, which permitted a two-fold increase in aircraft speed. Developed in England in 1941, turbojets were first used on U. S. military aircraft in 1944, and were introduced into commercial use with the Boeing 707 in 1958.

The advances seen in civil aviation to date have been primarily a result of government-sponsored research to develop military aircraft with greater speed, altitude, range, and load-carrying capability, and with the ability to fly in bad weather. It is typically 5 to 10 years from development to commercial application of a concept, and often the reliability must be proven in routine military use prior to incorporation in civil transport designs. Reference 22 provides an excellent summary of the history of aviation progress, including a documentation of the origin and timing of the most important technology advances.

The economic impact of the new technologies can be seen in figure 22. Although inflation of wages and materials have increased the cost of operating each individual aircraft, the introduction of larger, faster, more productive aircraft reduces the effect on the average operating cost of the airline fleet. This benefit is the source of the reduction in unit operating cost noted in figure 17, and is largely responsible for average domestic coach fare levels in 1972 being only 2% more than in 1962.

Figure 23 lists the elements of airline operating costs, along with areas of potential gain through technology. A major item is fuel, which now represents about 20% of total operating expenses, up from 10% in 1973. Fuel may be 25% to 30% of total operating costs by 1980. Means must be found to significantly reduce fuel consumption, and research into alternate fuels must continue as insurance against eventual unavailability of petroleum. Labor is still the largest factor in airline expenses, and opportunities for cost reductions exist in both aircraft design and in increased automation of ground equipment. The burdens of depreciation and insurance can be reduced through technologies which increase aircraft service life and reduce the price of equipment. Indirect costs such as landing fees and terminal rentals may become increasingly important due to current public emphasis on land use and ecology. Reductions in aircraft noise and pollution are presently being legislated, and future land use policy may increase the economic attractiveness of aircraft concepts with short field length or vertical takeoff and landing capability.

Fuel Utilization Efficiency

The cost of fuel to the U. S. scheduled airlines was $1.2 billion in 1973. It will be about $2.4 billion for 1974 and may reach $4.0 billion before 1985. The 1974 increase alone is more than twice the combined net income of the industry for the previous six years. Future reductions in fuel consumption through aircraft design improvements will therefore have a major impact on airline finances.

Figure 24 illustrates past and projected trends in fuel utilization efficiency of turbine-powered aircraft. It is clear that there have been, and will continue to be significant gains in seat-mile productivity per gallon of fuel consumed. These gains are the combined result of numerous minor and major technology advances in aerodynamics, propulsion, structures, and avionics.

The number of available seat-miles per gallon of fuel consumed nearly doubled from the earliest turbojet 707 and DC-8 aircraft to the stretched DC-8's of the mid 1960's. Much of this improvement came from the introduction of turbofan engines in 1960, which reduced fuel consumption of those aircraft by about 22%. Further gains were obtained through aerodynamic improvements and structural weight reductions, and design modifications for fuselage stretching allowed increases in seating capacity of 30% to 35% for only 5% to 9% increases in total fuel consumption.

Through further increases in seating capacity and utilization of efficient high-bypass ratio turbofans, the wide-body jets have provided the capability for further fuel economy. The potential gains have not been fully realized to date, however, because low passenger demand has caused the aircraft to be used with less than the intended number of seats. An average of 44 seat-miles/gal. were provided by the 747 and DC-10 in 1973 service.[23] This could have been 51 and 53 seat-miles/gal., respectively, with the design configuration of 382 seats for the 747 and 277 seats for the DC-10. Additional gains are possible through fuselage stetching. A 1978 version of the DC-10 could have 362 seats, which with minor improvements in aerodynamic design and engine performance may reduce fuel burned per seat by 15% to 25%.[24] Similar improvements are possible with the 747 or L-1011.

The pacing item in introduction of stretched aircraft is not technology, but market growth. Versions of the 747 with up to 730 seats for long-distance travel or 1000 seats for short ranges have been studied.[25] Demand for aircraft of this size, however, may not materialize for many years. In the meantime, there is a strong need for performance improvements which will reduce fuel consumption on aircraft of all sizes.

Figure 24 indicates that engines now in development could improve fuel economy of current 707, DC-8, and the other early jets by 20% to 30%. These engines offer higher thrust, lower operating costs, and lower noise and pollution levels. The cost to re-engine the current airline fleet of first generation jets would be about $4 billion,[26] however, and many of the early jets do not have sufficient remaining airframe life to justify this investment. An alternative would be introduction of derivative aircraft incorporating, not only the new engines, but also aerodynamic advances such as the supercritical wing developed by NASA in the late 1960's. Such aircraft could be available in the early 1980's.

Transport aircraft of the future will provide significant fuel savings through the use of technologies developed in the 1960's and 1970's. Near-term technologies which may see application in a 1985 fuel-conservative aircraft include the supercritical wing, composite structural materials, and advanced flight controls. An increase of 35% in aircraft fuel efficiency may result from these and other advances. Further gains by the end of the century are expected to double the fuel productivity of today's most efficient jets.[27]

The supercritical wing will provide aerodynamic performance improvements of about 15% as well as lower wing weight. The addition of vertical winglets on wing tips can reduce fuel consumption of both current and future aircraft by 5%. Other aerodynamic advances for far-term application include use of such new concepts as porous wing and tail surfaces or compliant skins to control turbulence and reduce skin friction. Considerable development testing will be required to make these concepts operationally viable.

Composite materials are expected to reduce fuel consumption by 10% to 15%, as a result of structural weight savings. Advanced composite materials programs of the Department of Defense and NASA have demonstrated weight savings of 30% for major aircraft components, and manufacturing cost savings are possible. Further research is needed on the mechanical properties of these materials, and additional operational experience must be gained prior to extensive application in a commercial transport.

Improved avionics, flight controls, and operational procedures may reduce fuel consumption by 5% to 10%. By reducing stability requirements of future transports with active controls it is possible to have shorter fuselages and smaller tail surfaces, reducing both structural weight and aerodynamic losses.

Advances in propulsion will account for additional fuel savings. Improved fan and compressor performance, higher by-pass ratios, more efficient combustors, and higher turbine operating temperatures will combine to reduce fuel consumption and improve engine thrust-to-weight ratios.

All of these technologies can combine synergistically to give benefits in both fuel economy and operatings costs which are greater than each individually. Improvements in aerodynamic efficiency and structural weight result in smaller engines. Since total fuel consumption is a function of engine size as well as engine efficiency, this reduces mission fuel requirements. Reduced fuel volume and engine size further reduce the size and weight of the airframe structure, giving a cascading effect on the aircraft performance.

Acquisition Price

Depreciation and amortization, and insurance of flight equipment combine to account for about 10% of all airline operating expenses. These costs, of course, are a function of the acquisition price of the aircraft fleet, since they represent provisions for possible future replacement.. There is, therefore, a strong economic incentive in fleet planning to achieve the minimum cost per seat which is consistent with aircraft size and speed requirements.

Figure 25 illustrates the unit cost of acquiring transport aircraft productivity, in 1972 dollars, with each of the principal transport models depicted. Several trends are apparent. First, there is a definite economy-of-scale effect, with the large, long range aircraft costing less per unit of productivity than small aircraft. Second, the wide-body transports and other new aircraft cost more for a given level of productivity than do the first-generation jets. Finally, the Concorde costs more than twice as much as a subsonic jet of the same productivity.

The size-related benefits appear from figure 25 to be limited to levels near those achieved with the current wide-body jets. Large new aircraft may provide modest reductions in price per unit of productivity, but greater gains are usually made with derivative aircraft based on stretching existing airframes. The best example of this is the DC-8-61, which provided nearly 50% greater productivity for a price about 20% greater than that of the basic DC-8.

The increase in unit acquisition price noted for the widebodies is largely the result of inflation. In general, each new generation of aircraft is developed and manufactured with inflated dollars, and will therefore cost more than earlier aircraft. In addition, for highly complex aircraft such as V/STOL or supersonic transports, significant technology advances are required. The additional research effort further increases development costs and unit acquisition price. This effect tends to offset some of the productivity increases provided by new aircraft designs.

Technology advances which reduce aircraft acquisition price as well as fuel consumption are highly beneficial to airline economic prospects. One recent advance which appears particularly promising is the use of advanced composite materials. These materials are making possible significant reductions in aircraft weight, and as new fabrication methods and cheaper materials are developed, small aircraft price reductions also appear likely.

Other technologies which reduce the size and weight of airframes and engines may also have a beneficial effect on future aircraft prices, but only if the design complexity does not greatly increase research and development requirements. Possible examples are the aerodynamic and flight control improvements discussed above.

Recent emphasis on ecological considerations will increase aircraft acquisition prices, as future aircraft engines will be both heavier and more expensive than would be the case without the need for reduced noise and emission levels.

A trend toward reduced technology transfer from military to civil aviation was established with the early jets, and this has adversely affected the price of new commercial transports. Historically, significant amounts of the capital and development costs of civil transports were provided through transfer of both "know-how" and hardware. During the 1940's there was direct hardware transfer, with only interior arrangements and equipment differing between some military aircraft and the commercial derivatives.[22] Civil aircraft development also benefited from use of Government-owned facilities, and from production methods and design-team expertise gained on military programs.

With the introduction of 707 and DC-8 transports it was technology, more than hardware, that was transferred. The advances in propulsion, structures, and aerodynamic design that made the early jets so efficient were developed on previous military programs. The 707 evolved from Boeing experience with the B-47 and B-52 bomber programs, and had a high degree of hardware commonality with the KC-135 tanker. The DC-8 had no military counterpart, but like the 707, used design and manufacturing techniques as well as engines derived from military aircraft.

The technology transfer was less for the wide bodies. Although both the 747 and DC-10 use engines which are commercial derivative of engines developed for the Air Force C-5A transport, the airframes for these aircraft and also the L-1011 were largely unsupported by military developments. Moreover, the tooling and manufacturing plants used to produce these aircraft are privately owned. As a result, the investment required to develop and manufacture the 747, DC-10, and L-1011 was in excess of $1 billion each.

To the extent that future design philosophies differ between civil and military aircraft the technology transfer may remain limited. Military aircraft are designed to specific mission requirements, and a degree of risk is acceptable in applying new technologies. Performance needs often override cost considerations. With civil transports, however, the primary considerations are safety, economy, long service life, passenger comfort, and now ecology.

The need to achieve low noise and low emission levels is a regulatory requirement, and the goal of reduced fuel consumption has become an economic and social necessity.

The combined effects of inflation and reduced transfer of military technology and hardware is likely to increase the price of future civil transports. The costs of noise abatement research are being borne primarily by civilian Government agencies and by private industry. The introduction of supersonic transportation has come first in the commercial sector, and the development of fuel-conservative airplanes probably will also. While many of the technologies required for both supersonic transports and fuel-conservative aircraft have originated with military programs, the development and manufacture of integrated transport designs will be civil ventures. Only in V/STOL aircraft for short-haul transportation is there a strong likelihood of direct hardware transfer from military programs to the commercial sector. This likelihood is based on the similarity in aircraft performance requirements for civil and military VTOL or STOL operations. Even in this case, however, there are large differences in the requirements for noise, economics, and ride quality between commercial and military designs.

Employee Productivity

Figure 26 illustrates productivity trends for airline employees and for three categories of labor: flight crew, mechanics, and administrative and ground service personnel. There has been a long-term increase in available seat-mile capacity generation per employee, averaging 7.5% compounded annually since 1960. This has been the result of increases in the size and speed of aircraft in service, increases in aircraft reliability, and increased automation of ground equipment.

The rapid increase in available seat-miles per airline mechanic is a result of several factors: (1) better reliability and maintainability of new flight equipment; (2) economies of scale; and (3) reduced frequency of overhaul with increased aircraft service time. Of these, the last may be the most important factor. The early years of an aircraft type are characterized by maintenance problems, high defect rates, and premature system removals. As operational experience is gained and modifications are made, reliability improves and the time between overhaul increases. For example, the time between scheduled major airframe overhaul for DC-8 and 707 aircraft has increased from 2500 flight hours in 1959 to about 18,000 hours now. The 747 was introduced with a 9000 hour maintenance interval, but is now up to 16,000 hours.

Technology advances are responsible for a paradox in airline maintenance expenses: both increases and decreases in maintenance labor can be traced to previous introduction of new technologies. Maintenance costs of new high bypass ratio engines on the wide-body aircraft are higher than those of earlier jet engines, causing some airline managers to recommend backing up to more conservative technology levels.[28] Yet, the demands for noise and pollution control as well as lower fuel consumption suggest that even higher bypass ratios and higher technology levels will be preferred if not required in the future. Avionics and electrical and hydraulic systems on new aircraft are more complex because they have more functions. As a result, maintenance problems with these components have increased despite the redundancy which has been provided. Built-in-test equipment and integrated data systems have been installed on board 747, DC-10, and L-1011 aircraft for the purpose of monitoring system performance and reducing maintenance manhours. To date, however, reliability problems with the monitoring systems themselves have proven disappointing to some airlines.

Many of these maintenance problems are a result of the "introductory" period in which the wide-body jets now operate. Based on experience with early jet aircraft, engine maintenance may be reduced by 50% as service life increases.[28] In addition, increased use of new ground-based automatic test equipment for engines and other system components promises to reduce future maintenance manhours. One airline now processes 1200 subsystems and components with automatic test equipment.[29] An inspection or test job that would require 12 hours of manual labor can be completed in 1 hour with this equipment.

The improvement in flight crew productivity has been less dramatic than that of airline mechanics. The gains achieved in the last 10 years have been primarily due to aircraft size increases which have improved the ratio of available seats to the number of cockpit crew members. No significant improvement has been obtained in cabin attendant productivity during this period. Since passenger-to-stewardess ratios are fixed by safety regulations and passenger service requirements, this situation is expected to continue.

Further increases in available seat-miles per cockpit crew member will be realized as growth in traffic demand brings an increasing number of large aircraft into service. However, reduced trip times, through use of supersonic transports, would markedly improve productivity of both cockpit crew and passenger attendants on long flights. Smaller gains would be achieved with V/STOL transports in short-haul service, due to reduced terminal area delays. Better air traffic control and aircraft avionics, along with fog dispersal methods and automatic landing systems, will improve flight crew productivity by reducing flight delays due to airport congestion and bad weather.

Advances in electronics could reduce the number of crew members needed to fly an aircraft. Just as the requirement for a navigator on long flights has been eliminated with inertial navigation equipment, so too could the flight engineer be replaced by computer monitoring of electrical, hydraulic, and power subsystems. It may be possible to eliminate the need for a copilot in the future, through remotely-piloted vehicle technology. A ground-based pilot, for emergency take over only, could be available for several flights simultaneously, with only a single airborne pilot for normal operations. While this procedure would increase crew productivity, considerations of passenger acceptance and safety may not permit implementation.

The productivity of administrative and ground service personnel has doubled in the past 10 years. Much of this has been a result of traffic growth and the use of more productive aircraft. Higher traffic flow provides a better ratio of passengers to employees, and improves utilization of personnel. There have also been gains through automation of functions such as reservations and ticketing, baggage and cargo handling, flight control, spare parts inventory, and customer billing. Airline acceptance of automation for all aspects of business is now growing rapidly, although many applications are still experimental and some have given problems. Future increases in the use of computers and automatic equipment for traffic service as well as other activities seems certain.

Many airlines now employ computer-based passenger processing systems incorporating automatic ticket and boarding-pass printers. With passenger names and iteneraries as well as seat inventories now being maintained by computer, reservation department productivity is up by as much as 80% over the last 5 years.[30] Airlines are looking beyond present systems for automatic printing and processing of tickets. Equipment is being considered with objectives such as: (1) total elimination of the ticket coupon through credit card readers which will issue only a boarding pass; (2) automatic self-ticketing for passengers with reservations and an acceptable credit card. Experimental installations of each type of system have been or will soon be tried. Widespread use could be in effect in the near future.[31]

Automation in baggage handling and freight control has been slow to develop. New systems based on laser scanning devices or voice-activated encoding systems have been developed for baggage sorting. Cargo containerization has been helpful. However, many airlines reject the concept of a fully-automated cargo warehouse or baggage system because of the lack of flexibility without people in the loop.

The economic impact of airline automation is significant. One large airline, which carries about 8% of all U. S. airline traffic, estimates that it saves nearly $100 million annually with its computer system.[32] Although most airlines do not yet have such extensive automation throughout their operations, the potential for future gain is large. With labor representing about 40% of total expenses, large productivity gains are needed to offset future wage increases. By doubling overall employee productivity, as during the last 10 years, operating cost would be much less than otherwise. The savings since 1963 amounts to 1.6¢ per seat-mile, or 10¢ per available ton-mile, at today's labor rates. Similar savings could be achieved in the next decade.

<u>Terminal Area Operations</u>

One airline expense which has been rapidly increasing in recent years is that associated with the use of airports. Landing fees and terminal rentals at most major airports are used to recover operating costs of the airport as well as principal and interest on airport improvement bonds. These costs amount to several hundred million dollars annually.

Other costs indirectly associated with the terminal area include the cost of reducing the environmental impact of aircraft operations. The need to improve the community acceptance of airports has led to a requirement for greatly reduced noise and pollution levels from new aircraft. While engines now in development provide significant reductions in both emissions and noise, the cost to develop the technology results in much higher engine prices.

Limitations on night operations at some airports result in a loss of revenue to the airlines and under-utilization of equipment. Lawsuits in high-noise areas around some airports constitute a potential major expense to the industry.

Airport congestion has periodically been a source of economic penalty, and is estimated to have cost the industry about $158 million in crew, fuel, and aircraft expenses in 1969.(33) While less of a problem recently, airport congestion is expected to again become serious when future traffic exceeds the capacity of runways and air traffic control facilities. Expansion of present airports is limited by land availability, and construction of new airports is expensive, and often meets public resistance as well.

Technology advances which provide reduced land use will lower landing fees and airport rentals. This can be achieved through reduced runway length requirements and closer spacing of runways. Close runway spacing requires more accurate approach and landing control techniques and better methods of dissipating wake turbulence. Current NASA/FAA flight research is developing advanced guidance systems and operational procedures, as well as new means of reducing vortex generation by aircraft. These efforts will also help reduce future airport congestion by increasing the maximum number of hourly operations which can be allowed without compromising safety.

Airport congestion can be partially alleviated by the development of aircraft able to takeoff and land in all weather conditions, and by new techniques in fog dispersal. Continued increases in aircraft size will also assist by increasing the number of passengers moved per aircraft operation. Perhaps the greatest gains in land use reduction and congestion alleviation will come from introduction of VTOL or STOL aircraft. Through substantial reductions in runway length requirements, airports can be made smaller and multiple runways can be constructed.

The use of V/STOL aircraft may also provide noise relief in airport communities. Despite the need for large engines to achieve short-field capability, V/STOL aircraft tend to be quieter than conventional aircraft because they use very little runway and have steep climb and landing approach angles. Thus, the noise footprint can be contained within the airport boundaries to a greater extent than with conventional aircraft.

CONCLUSIONS

It has been noted that the U. S. scheduled airline industry has experienced very erratic profitability despite a history of impressive revenue growth. Factors affecting the profitability of this industry are numerous and interrelated, and great care must be exercised to avoid oversimplification when analyzing the sources of previous instabilities. In this study, an attempt was made to objectively assess causes of past economic problems and prospects for future improvement without making policy judgements or recommendations.

The results of the study indicate that fare levels are not the primary source of industry financial problems. Specific examples of operating costs in excess of fare levels exist in certain short-haul markets and on routes with low traffic density, and there are highly competitive routes such as the transatlantic which have been unprofitable due to fare discounting. Overall, however, the average revenue yield has been adequate for a reasonable industry profit performance, and fare increases have been commensurate with growth in the cost of operation.

The profit erosion of the late 1960's and early 1970's was due primarily to excess capacity. This was reflected in declining load factors and reduced operating profit margins. A permanent return to the load factors of the mid-1960's should do much to bring a return to the prosperity enjoyed by the industry in that period.

Poor load factor control is a chronic problem of the airline industry. Direct competition often results from the existence of many routes with two or more carriers. As it is a highly regulated industry, the number of competitive modes available to the participants is restricted. Since price competition is very limited, there is intense competition in the remaining competitive modes, such as the quality of service and frequency of flights offered. Frequency competition often leads to overcapacity, which increases the cost of operation and reduces profitability.

Other factors also affect load factor control: volatility of traffic demand; the need to purchase planes large enough to remain viable in the market which may triple during the 12 to 16 years aircraft service life; the provision of service in communities where traffic levels are low; the necessity of adding capacity in complete plane-loads, when traffic growth on the route may justify smaller capacity additions. Each of these contributed to the load factor declines of the late 1960's, and may continue to be a problem in the future.

Airline expenses have escalated more in the last year than at any previous time. Much of this has been due to fuel price inflation. Fuel now represents about 20% of airline operating expenses, and increases are likely as expiring fuel contracts are renegotiated at current prices. The average price of jet fuel has increased from 11.5¢/gal in 1972 to nearly 25¢/gal in 1974, and is 35¢/gal or more on new contracts. Total industry expenses are increased by about $100 million for each 1¢/gal fuel price increase.

Fuel consumption per available seat-mile is about 20% to 30% lower for wide-body transports than for the early jets. This is a result of both increased aircraft size and technology advances. Further improvements in aerodynamic efficiency and engine performance will permit an additional 20% or so reduction in fuel consumption with the next-generation transports. More advanced technologies now being researched may reduce fuel consumption by 50% from wide-body levels by the end of this century. Increased development effort by the U. S. Government could accelerate this timetable.

Future traffic growth rates may remain lower than those of the 1960's, as air transportation is a maturing industry. Even modest traffic growth, along with the need to replace aging aircraft and to meet new environmental standards, will create very large capital requirements for the airlines. To provide the estimated $20 billion needed in the period 1976 to 1980 will require considerable outside financing plus net profits of over $600 million per year. This is equivalent to about a 9% return on investment, and will require an operating profit margin of 5¢/revenue ton-mile, approximately twice the levels of 1972/1973.

A 5¢/RTM operating profit margin can be achieved with load factors equal to the CAB guidelines, but future fare increases may be required if productivity gains are not sufficient to offset inflation in fuel, labor, and other costs.

Increases in productivity of airline labor have been a major factor in preventing more rapid fare increases in the past. The output of available seat-miles per employee has doubled since 1963, and further increases will result from present trends in the industry. Automation of reservations and ticketing as well as other ground services is progressing rapidly. Continued increases in average aircraft size will provide a better ratio of available seats to number of employees.

The future introduction of supersonic transports for long distance travel, and V/STOL aircraft for short-haul service, would reduce trip times and improve airline employee productivity. The V/STOL transport concepts also offer increased passenger convenience, reduced land use, and lower airport community noise. However, with presently available technology both supersonic and V/STOL transports may adversely affect operating economics. Advances in aerodynamics and propulsion, as well as other technical disciplines, are required to improve the economic feasibility of these concepts.

Inflation, emphasis on environmental improvement, and reduced transfer of technology and hardware from military to civil aviation will combine to increase the acquisition price of future transports. This puts new aircraft at an economic disadvantage in competition with early jets developed and manufactured at lower labor rates. The result is to delay the realization of improvements in fuel conservation, airport environment, and transportation service available with the new aircraft. This effect can be offset by increased aeronautical development effort by the civilian agencies of the U. S. Government, or by new economic incentives for industry.

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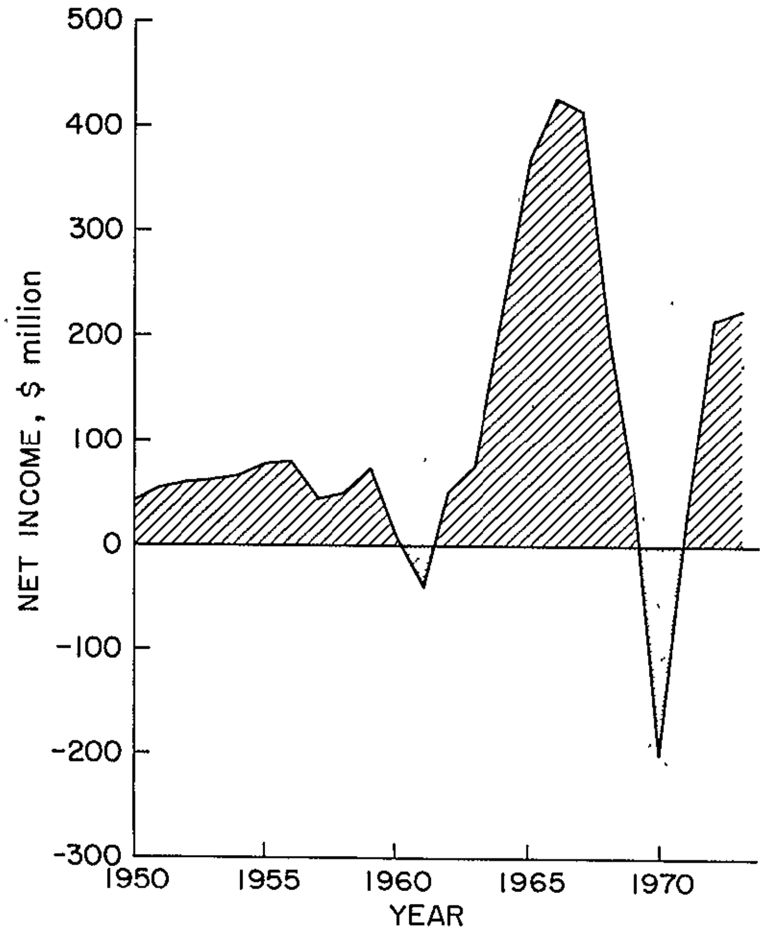


FIGURE 1. PROFIT HISTORY OF THE U. S. SCHEDULED AIRLINES

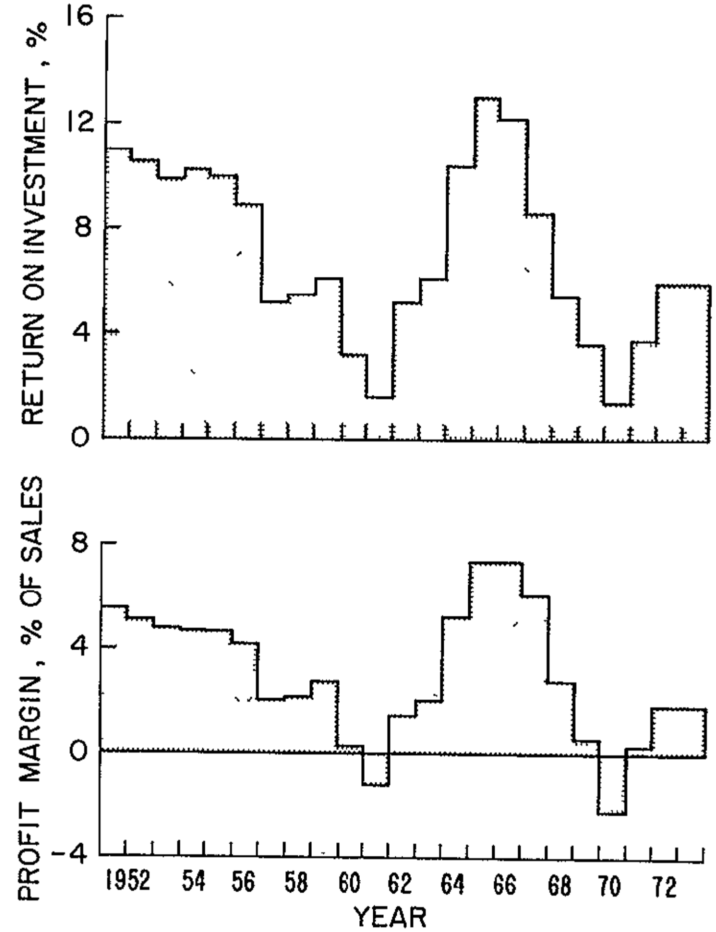


FIGURE 2. RETURN ON INVESTMENT AND PROFIT MARGIN HISTORY–U. S. SCHEDULED AIRLINES

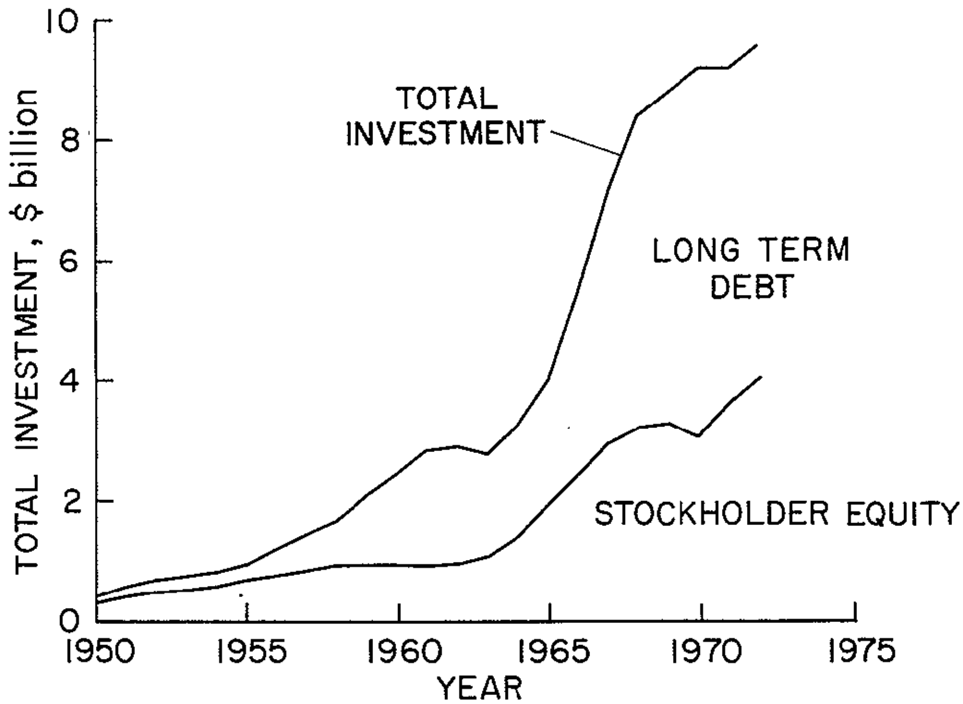


FIGURE 3. GROWTH OF LONG TERM DEBT AND STOCKHOLDER EQUITY

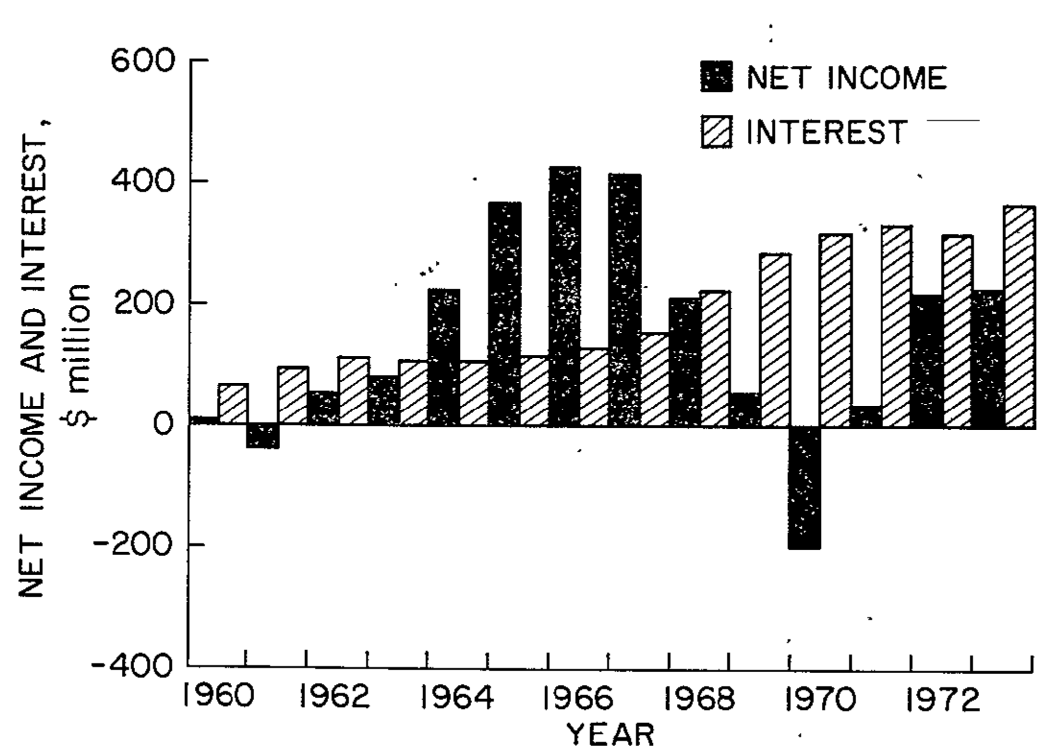


FIGURE 4. COMPARISON OF NET INCOME AND INTEREST ON DEBT

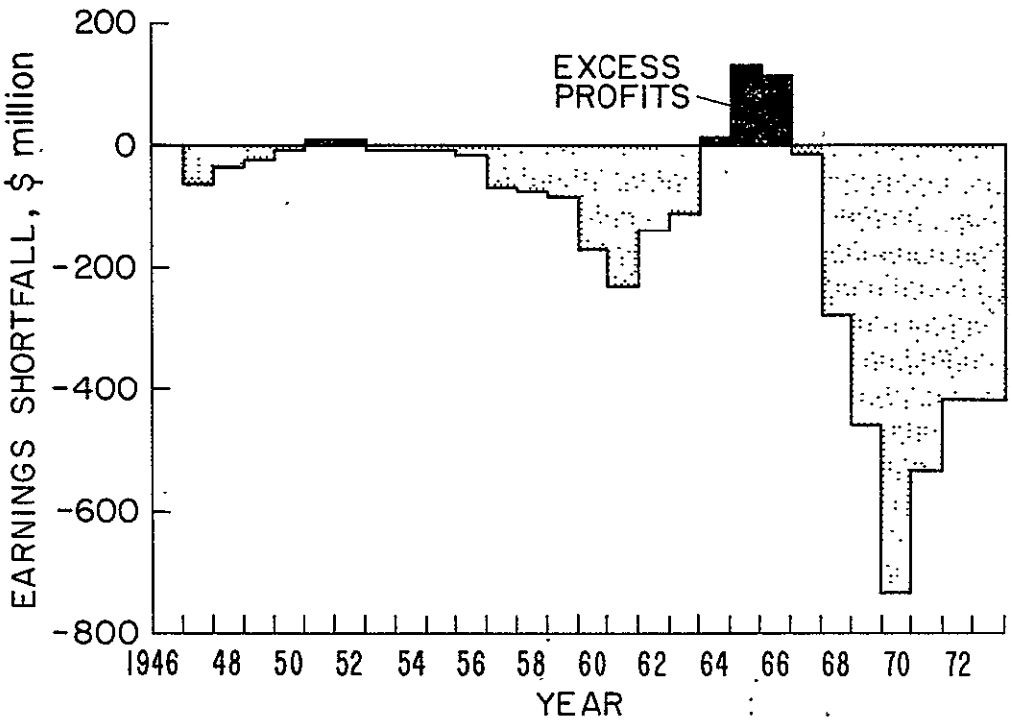


FIGURE 5. ANNUAL AIRLINE EARNINGS SHORTFALL (BASED ON 10.5% ROI GUIDELINE)

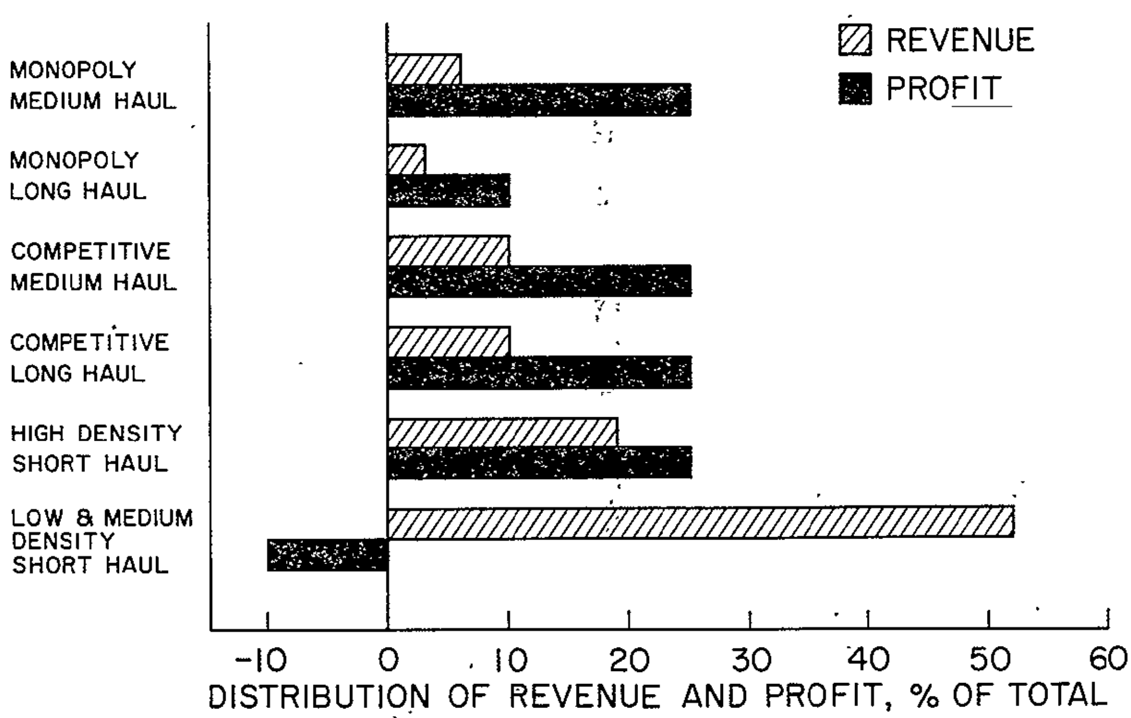


FIGURE 6. RELATIVE PROFITABILITY OF TRAFFIC GENERATED IN DIFFERENT MARKETS

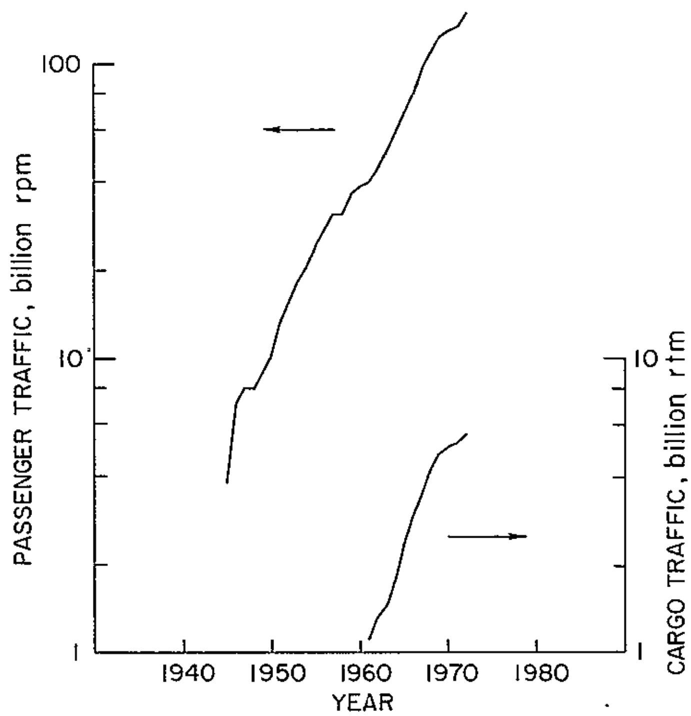


FIGURE 7. U.S. SCHEDULED AIRLINE TRAFFIC GROWTH

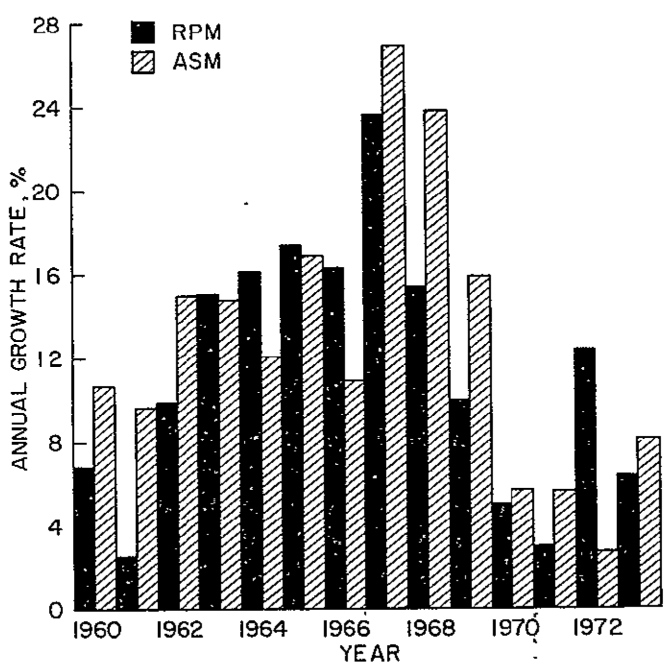


FIGURE 8. ANNUAL GROWTH RATE OF REVENUE PASSENGER MILES AND AVAILABLE SEAT MILES

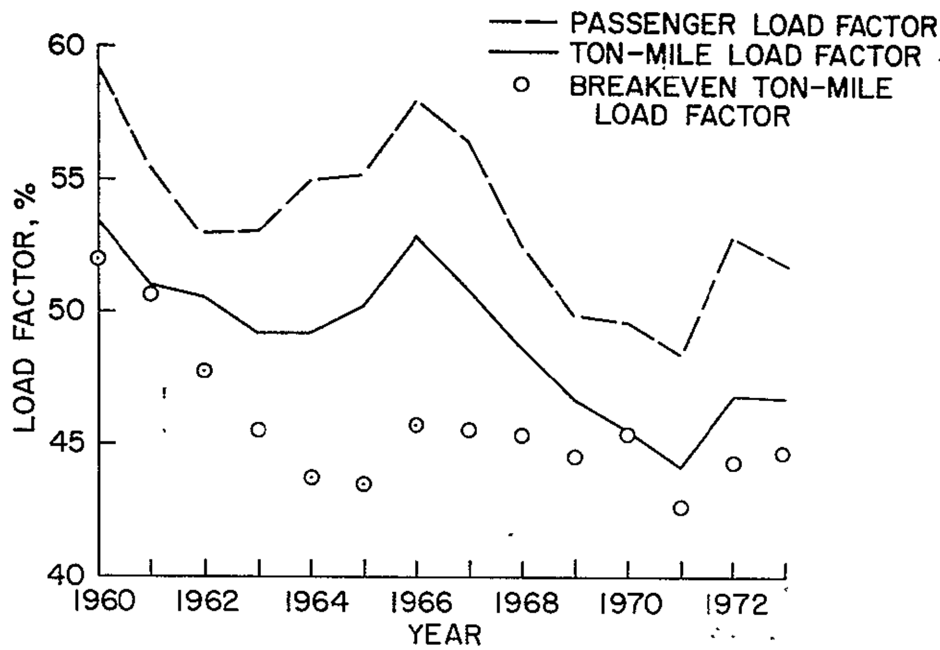


FIGURE 9. LOAD FACTOR TRENDS

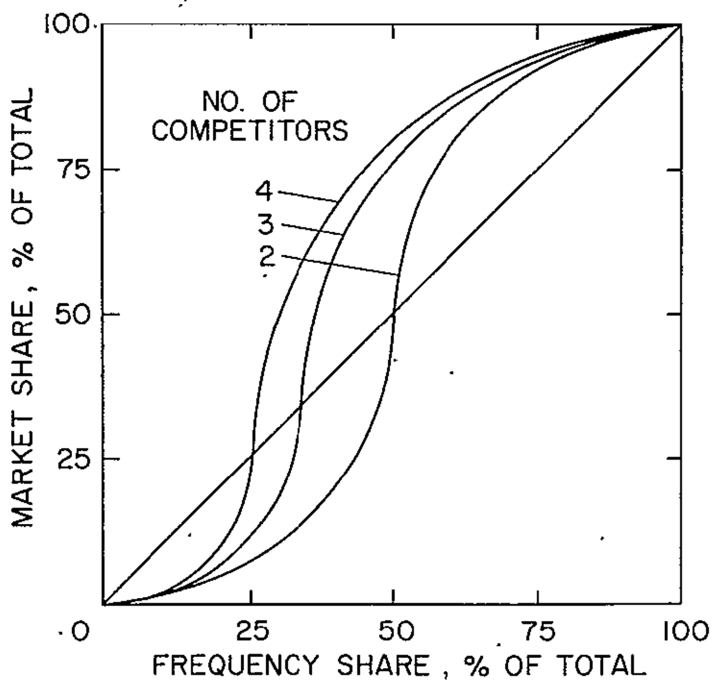


FIGURE 10. RELATIONSHIP BETWEEN FLIGHT FREQUENCY SHARE AND MARKET SHARE

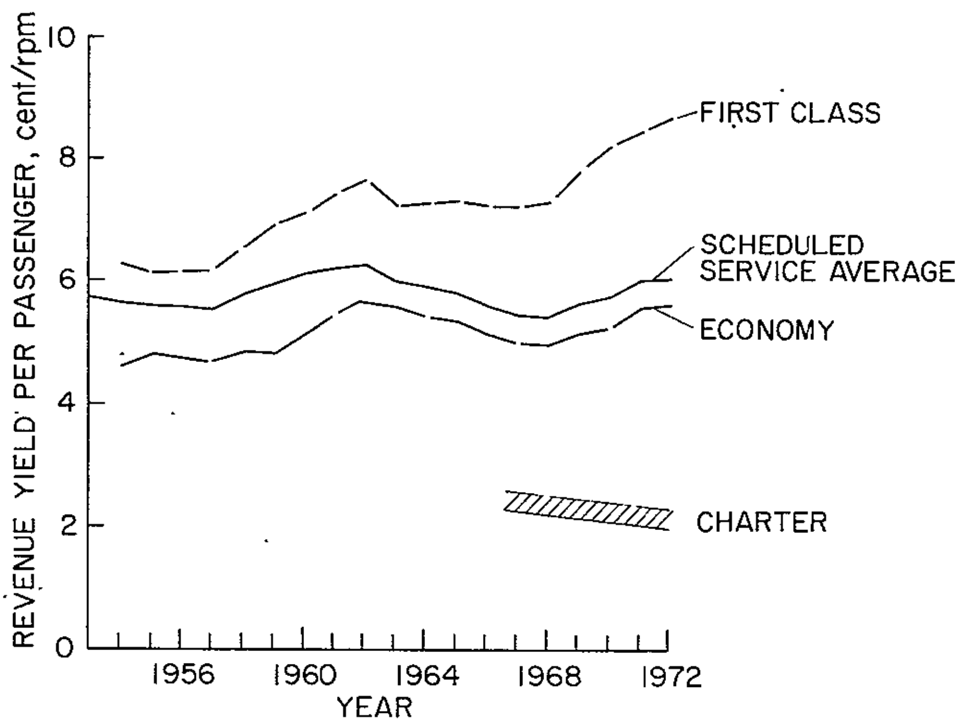


FIGURE 11. PASSENGER REVENUE YIELD TRENDS IN SCHEDULED SERVICE AND CHARTER OPERATIONS

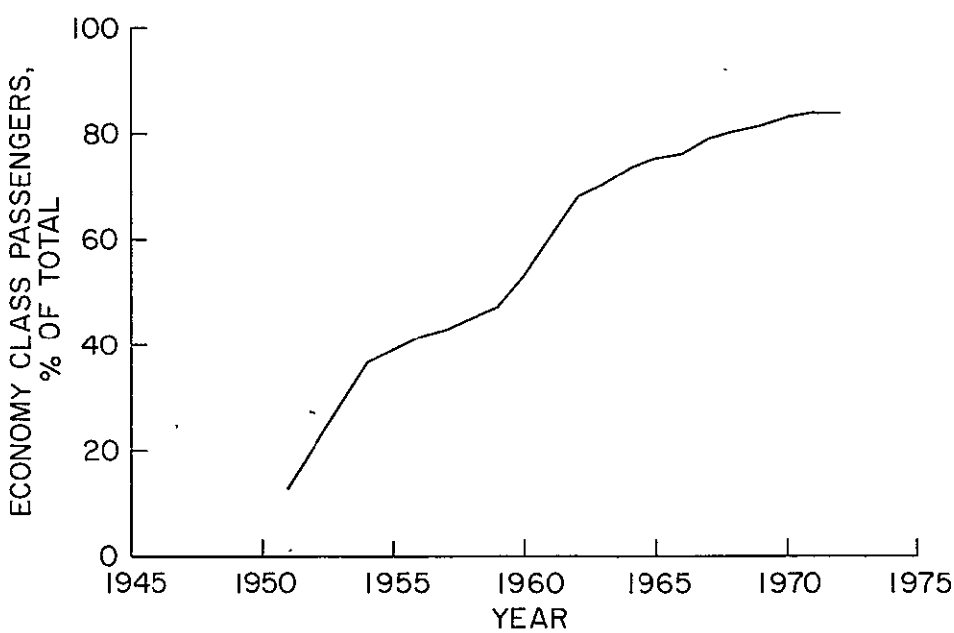
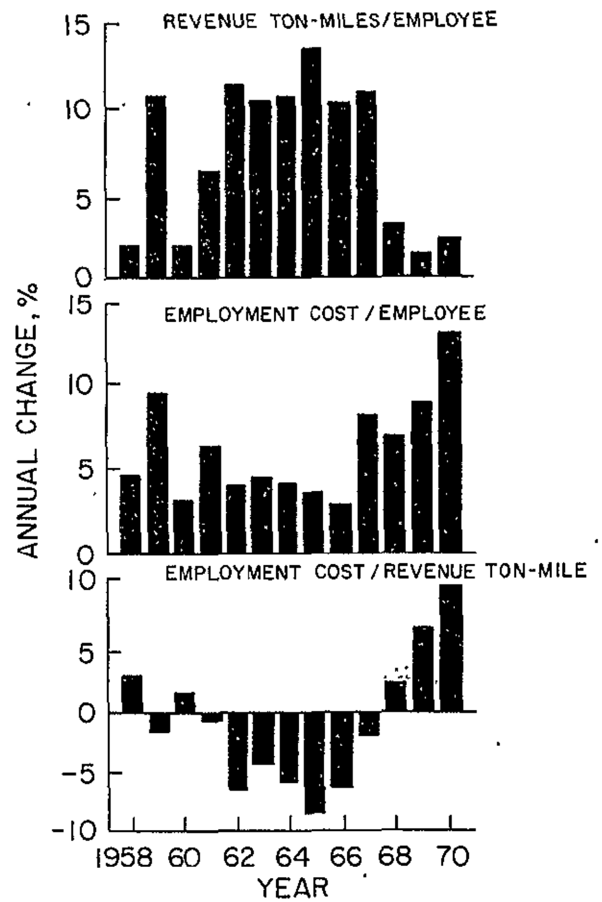


FIGURE 12. GROWTH OF ECONOMY CLASS PASSENGERS

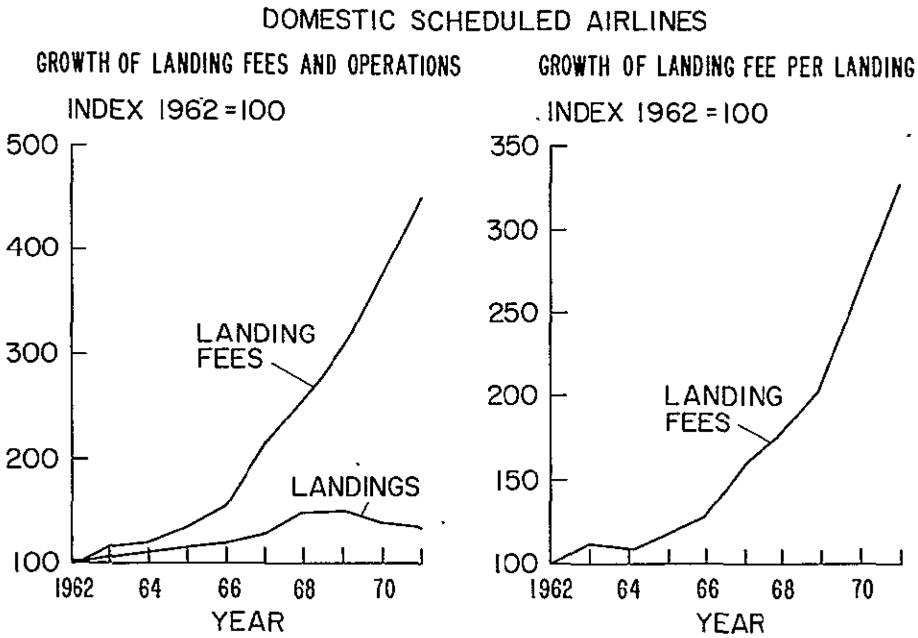
	1965/66	1969/70	1972/73
FARE LEVEL, cent/rpm			
FIRST CLASS	10.1	10.6	11.6
ECONOMY	6.3-7.2	6.6-7.6	6.4-8.4
DISCOUNT	5.0-5.5	3.9-5.5	3.0-5.8
AVERAGE YIELD, cent/rpm	5.44	4.98	4.55
OPERATING COST, cent/asm	3.09	2.90	3.05
BREAKEVEN LOAD FACTOR, %	57	58	67
ACTUAL LOAD FACTOR, %	54.	52	51

FIGURE 13. OPERATING ECONOMICS ON THE NORTH ATLANTIC



SOURCE AIRLINE MANAGEMENT - OCTOBER 1971

FIGURE 14. AIRLINE LABOR PRODUCTIVITY TRENDS



SOURCE: AIR TRANSPORT 1972

FIGURE 15. TRENDS IN AIRCRAFT LANDING FEES

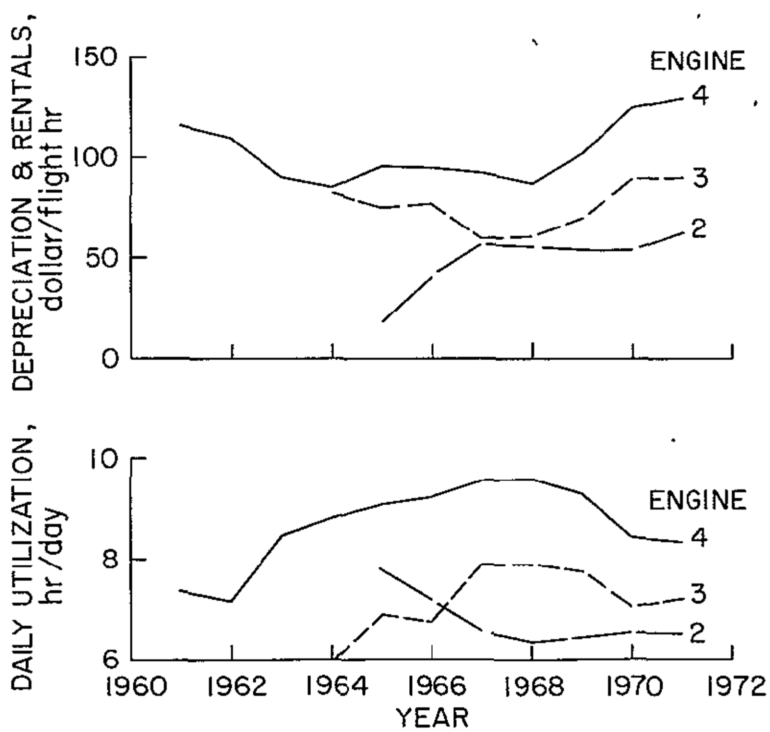


FIGURE 16. DEPRECIATION CHARGE AND AVERAGE DAILY UTILIZATION OF TURBOFAN AIRCRAFT — DOMESTIC TRUNK AIRLINES

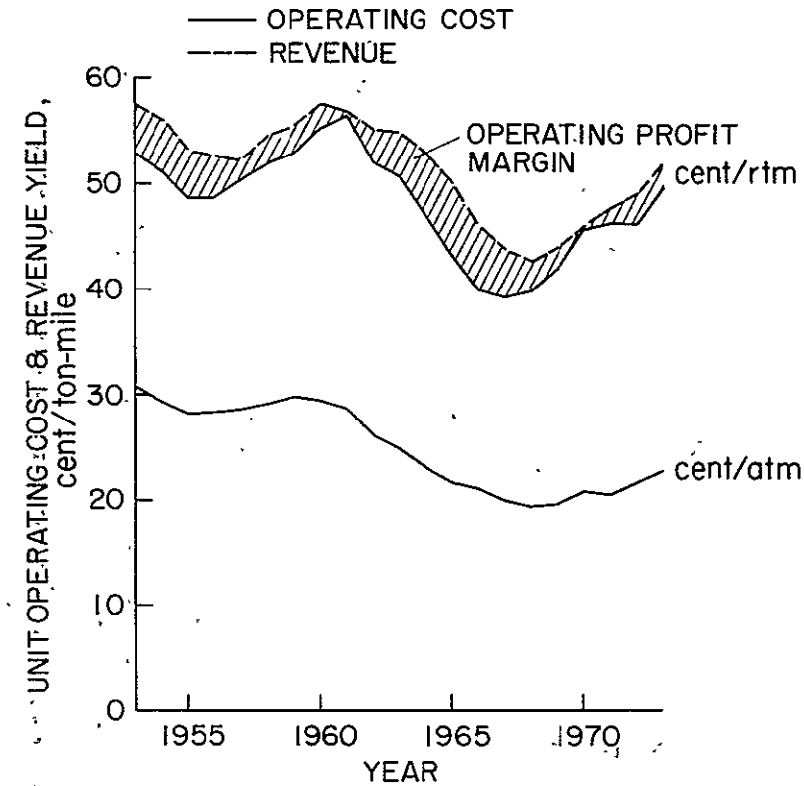


FIGURE 17. TRENDS IN UNIT OPERATING COST AND REVENUE YIELD

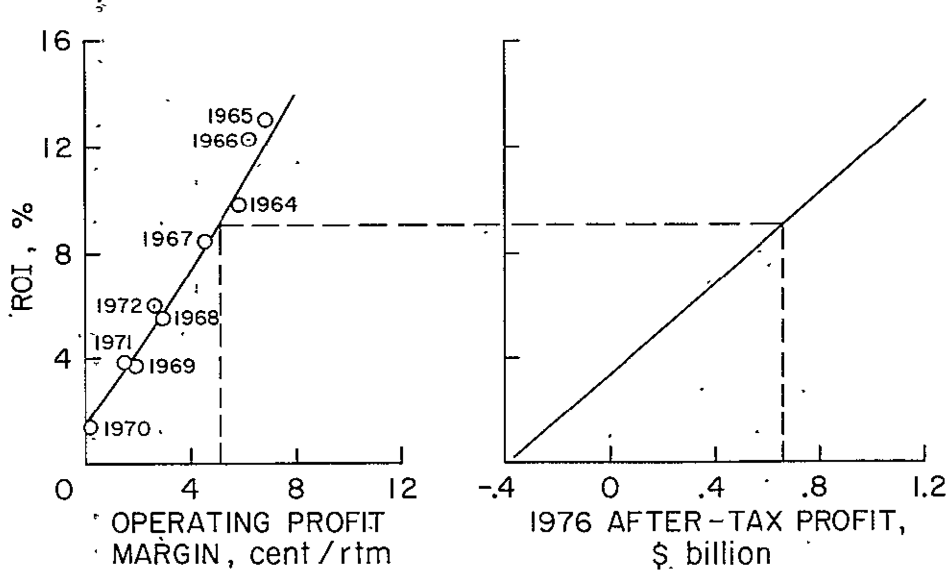


FIGURE 18. 1976 PROFIT ANALYSIS — U. S. SCHEDULED AIRLINES

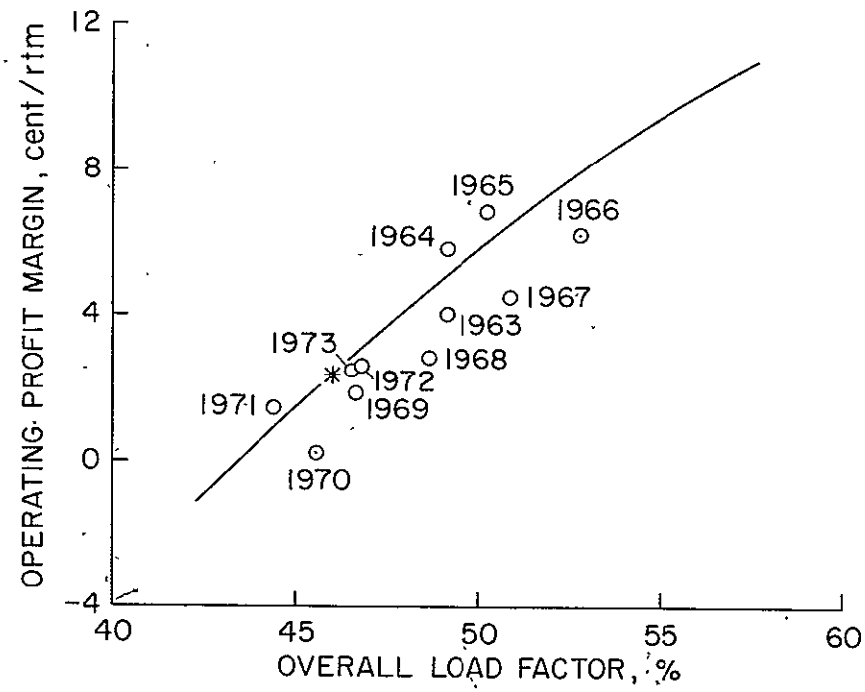


FIGURE 19. PROFIT MARGIN IMPROVEMENT WITH LOAD FACTOR

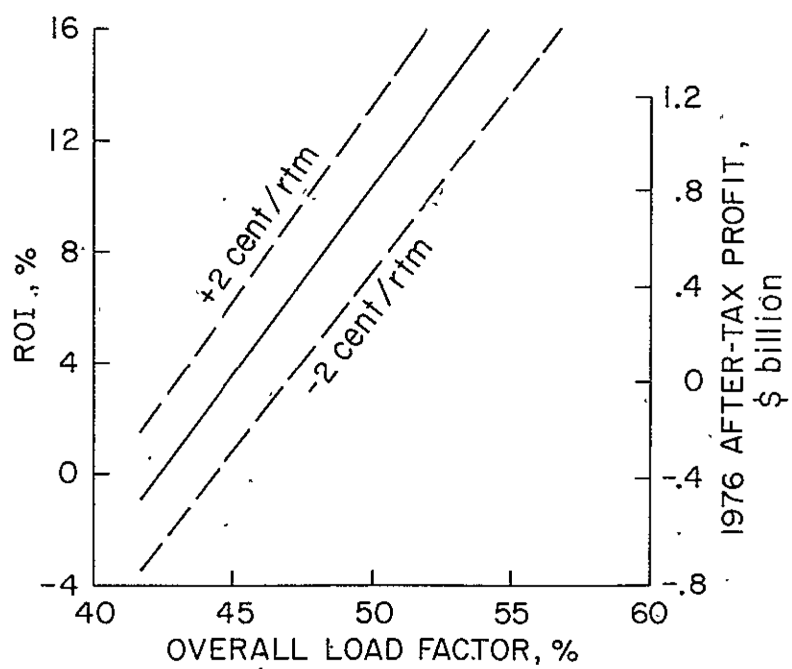


FIGURE 20. INDUSTRY PROFIT SENSITIVITY TO FARE LEVEL CHANGES

AIRCRAFT	YEAR INTRODUCED	CRUISE SPEED, mph	AVAILABLE SEATS	PRODUCTIVITY, seat mi per hr
CURTIS JENNY	1925	93	1	93
DC-3	1936	192	21	4,000
DC-4	1946	227	44	10,000
DC-6B	1951	310	64	20,000
707-120	1958	540	130	70,000
DC-8-61	1966	580	190	110,000
747	1970	580	382	220,000

FIGURE 21. TRENDS IN AIRCRAFT PRODUCTIVITY

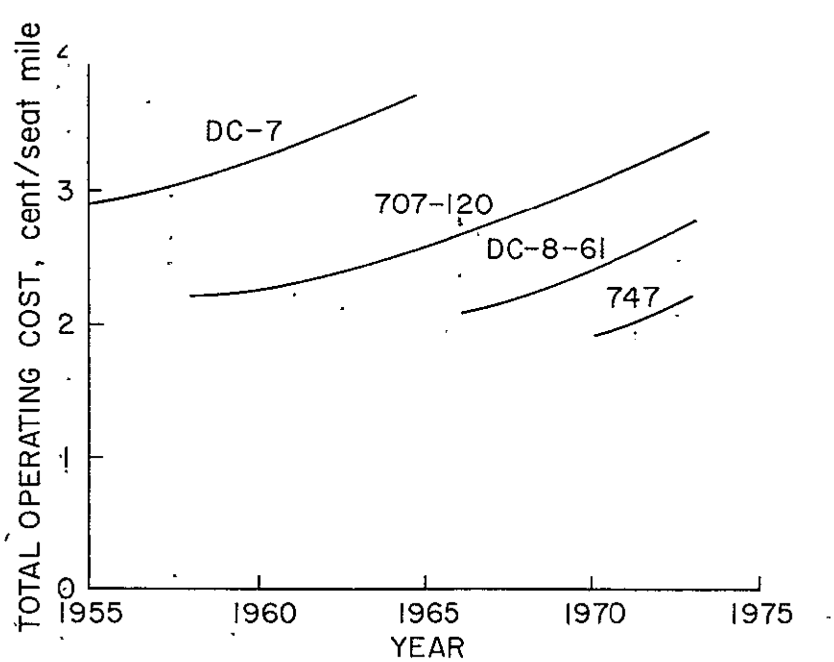


FIGURE 22. IMPACT OF TECHNOLOGY AND INFLATION ON UNIT OPERATING COSTS

COST ELEMENT	ESTIMATED PERCENT OF TOTAL EXPENSES 1974	TECHNOLOGICAL POTENTIAL	REQUIRED RESEARCH
FUEL	20	BETTER FUEL ECONOMY	ADVANCED ENGINES, LIGHT WEIGHT STRUCTURE, AERODYNAMICS & FLT CONTROLS
		ALTERNATE FUELS	COMBUSTOR TECHNOLOGY
LABOR — FLIGHT CREW	13	AIRCRAFT PRODUCTIVITY	HIGH SPEED & V/STOL AIRCRAFT, ALL-WEATHER CAPABILITY, TERMINAL AREA OPERATIONS
MAINTENANCE	6	INCREASED RELIABILITY	IMPROVED SUBSYSTEMS
GROUND SERVICE & ADMINISTRATION	21	AUTOMATED GROUND SYSTEMS	COMPUTER TECHNOLOGY
DEPRECIATION, INSURANCE	9	REDUCED AIRCRAFT PRICE	COMPOSITE MATERIALS, HIGH THRUST/WEIGHT ENGINES, IMPROVED AERODYNAMICS
		INCREASED AIRCRAFT SERVICE LIFE	IMPROVED MATERIALS, FAILURE DETECTION SYSTEMS
LANDING FEES, AIRPORT RENTALS	7	REDUCED LAND USE	V/STOL AIRCRAFT
		REDUCED NOISE & POLLUTION	ADVANCED ENGINES, TERMINAL AREA OPERATIONS
ADVERTISING, SALES COMMISSIONS, FOOD & BEVERAGES, MISCELLANEOUS GOODS & SERVICES	24		

FIGURE 23. THE POTENTIAL OF TECHNOLOGY

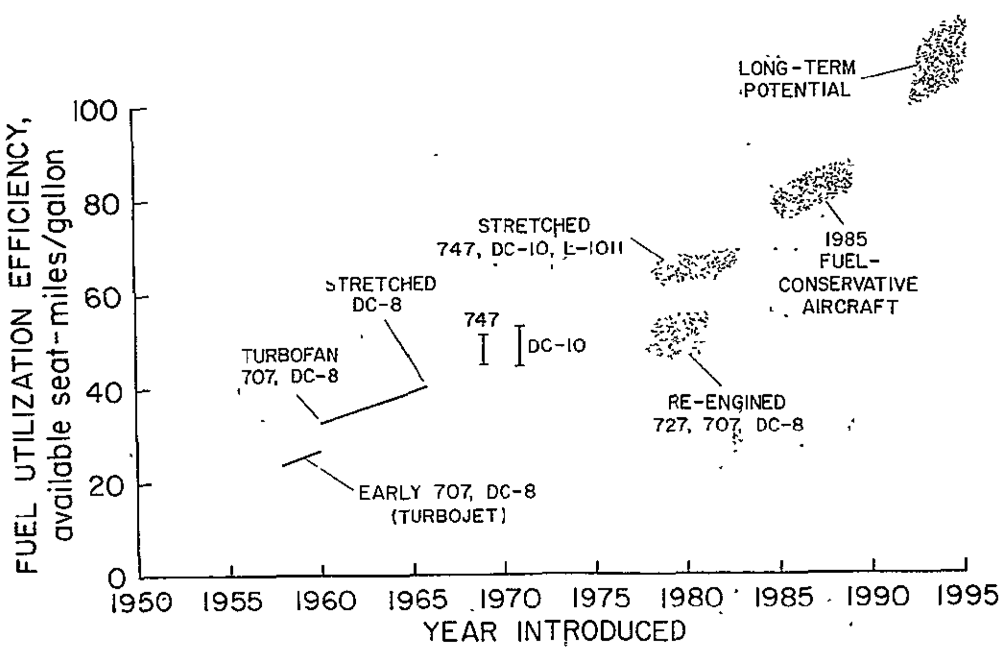


FIGURE 24. FUEL UTILIZATION EFFICIENCY OF TURBINE AIRCRAFT

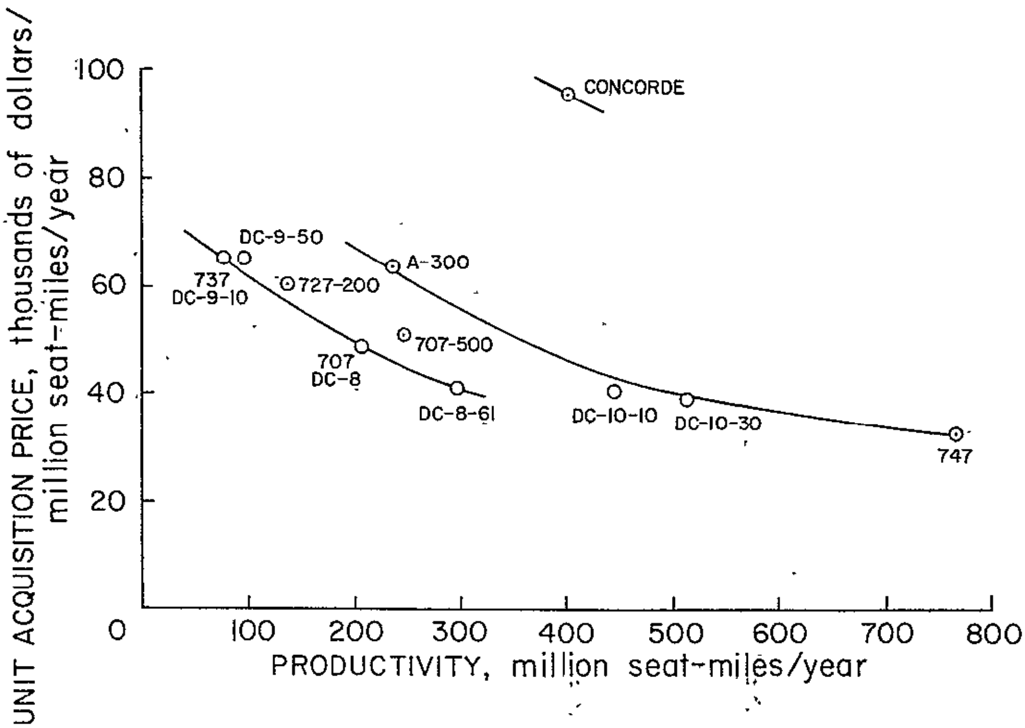


FIGURE 25. THE COST OF ACQUIRING TRANSPORT AIRCRAFT PRODUCTIVITY

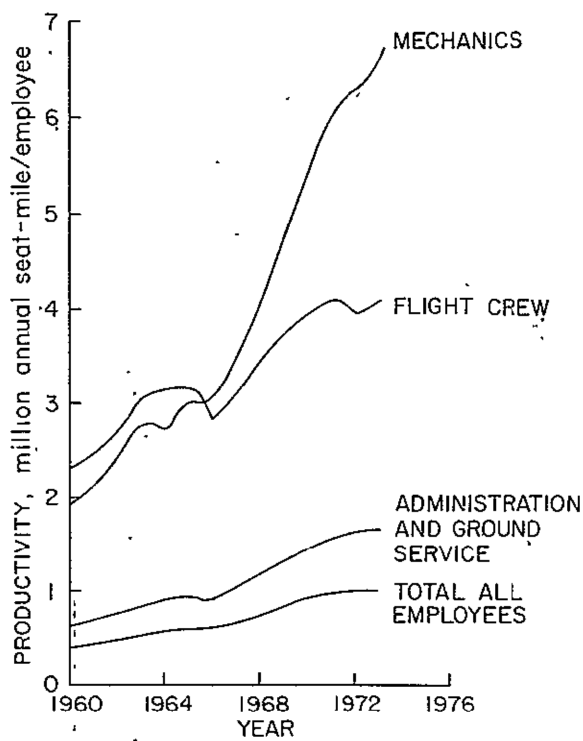


FIGURE 26. EMPLOYEE PRODUCTIVITY TRENDS