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Exposure to Uncertainty and Risk in Future Airline Investment Decisions

by Frank Bernardino

PAST STUDIES have described airline investments as being determined primarily by the competitive advantage inherent in introducing technologically advanced aircraft.[1] Essentially, no airline could previously afford to be without new aircraft which traditionally were faster, could fly further with larger payloads and greater fuel economy, and facilitated better aircraft utilization at lower maintenance and direct costs than the previous generation of aircraft.

But impending airline reequipment decisions may be determined more by other factors than by technological change. The need for ever larger planes has apparently been satisfied (at least temporarily) by wide-body aircraft, and faster aircraft cannot provide the fuel efficiency required today. Without these two demand stimulating characteristics of new aircraft, their competitive advantages are likely to hinge primarily on economics, the need to satisfy new regulations, and a host of factors which are uncertain or at risk and whose importance was previously obscured by the high growth in demand for air service and the need to respond to competitive acquisitions. Add to this the decline in the ability of the industry, much like other industries, to finance physical capital, and the picture of future airline acquisitions is clouded to the point where DOT has considered financing some replacements and retrofits in the 1980's.

This paper discusses the changing and newly emerging determinants of airline investment decisions and reveals the increased exposure to risk and uncertainty which must now be faced by carrier decision-makers, and holders of their debt. Yet, despite the increasing difficulty in arriving at intelligent reequipment decisions, it is possible that the outcome may more closely approximate an optimal allocation of resources than has previously characterized the industry. That is, if (as a result of the changing and newly emerging determinants of airline investment decisions) aircraft overcapacity in the industry is reduced, resources will be freed for other uses in the airline or other industries.

TRADITIONAL DETERMINANTS OF INVESTMENT

A significant body of literature exists concerning the determinants of airline investment decisions;[2] to conserve space, I will explore only the major changes I foresee in those determinants. The discussion is, therefore, only part of a larger analysis which is beyond the scope of this paper. Thus, what follows are descriptions of tendencies, without mention of opposing forces.

CARRIER COMPETITION

Under CAB regulation, carriers compete in the short-run by altering capacity along specific routes in an attempt to increase market shares. In many cases, it can be shown that market share is a stable function of relative capacities between carriers on specific routes.[3] This stability breaks down when aircraft embodying new technologies are introduced into a market. Such new aircraft tend to stimulate demand, divert traffic from other carriers, and increase productivity. To illustrate this, consider the following: In 1959, load factors of the newly-introduced jets were, on the average, over 90 percent, while the capacity use of other aircraft was between 50 and 60 percent. Some of this jet traffic was newly stimulated and some was former propeller aircraft traffic diverted to jets.[4] At the same time, the operating costs of jet aircraft were nearly 50 percent less than "comparable" piston aircraft. For example, in 1965, the cost per seat-mile of the most efficient piston aircraft, the DC-6B was 2.35 cents per seat-mile, compared to 1.24 cents per seat-mile for DC8-50's.[5]

The advantages of both higher productivity and the appeal of new aircraft are clear. Both airline and aircraft manufacturers must respond to the introduction of such aircraft by their competitors with aircraft of at least equal virtue.[6] This behavior explains, in part, the commonality between aircraft of the same generation — e.g., DC-10's and L1011's — and also the ever-present excess capacity in the service competitive industry.

What has changed is the fact that no technologically superior aircraft are likely to emerge in the next ten to fifteen years. As a result, the twin attributes of passenger appeal and higher productivity are likely to be absent from future aircraft acquisitions. Thus, the need to acquire aircraft in order to effectively compete on a day-to-day basis will be diminished.

The importance of this change in the characteristics of future aircraft needs to be emphasized. Consider the following simple economic model.[7] Let:

(1) $Q_d = Q_d\ (\overline{P}, Q_e)$,

where Q_d is the quantity of air transport demanded, $\overline{P}$ is the regulated price which is assumed to be constant and Q_e is the quantity of new flight equipment. (For this illustration, ignore other determinants of demand.) Under this specification of demand, the profit function of the airline is:

(2) $\overline{11} = \overline{P}q_d - Cq_d - C_e q_e$,

where q_d is quantity of service provided, C is the unit cost of service, CE is the cost of a new aircraft and Qe is the quantity of new aircraft acquired. Differentiating (2) with respect to Qe, find:

(3) $Ce = \partial qd / \partial qe\ (\overline{P}\text{-}C)$

in order for the monopolist to maximize profits. That is, additional new aircraft should be acquired until the cost of the last one bought just equals the additional net revenue it generates.[8] Since, in most cases, airlines are not monopolies, they view new aircraft as a means to stimulate demand and thereby capture added shares of markets. If all airlines operate under these assumptions, the demand stimulating effect $(\partial qd / \partial qe)$ will be overestimated. New acquisitions will exceed the profit maximizing number for the industry and overcapacity results. But, if new aircraft are no longer stimulants of demand and, more importantly, are not perceived as such by airlines, the tendency towards overcapacity in the industry will (within the confines of the model) be significantly reduced. Indeed, the service competition resulting from regulated prices will be the only factor of major importance driving the industry toward overcapacity.

If it were not for a series of other factors which are either changing or have only recently become part of the decision calculus, it could be stated with near certainty that future aircraft acquisition decisions would be more optimal, simply because of the absence of the destabilizing effects of the competitive behavior just described. Unfortunately, such a conclusion cannot be made, at least not without the following caveats.

GROWTH

The airline industry has had little experience with relatively slow growth in demand. For example, in the period 1960 through 1968, the average annual growth in domestic revenue passenger miles was 14.4 percent. Yet, from 1970 through 1975, domestic revenue passenger miles grew at an average annual rate of 4.4 percent; the comparable figure for international growth was 2.4 percent. The high growth rates of the previous period explain the confidence with which carriers entered the "wide-body era." The second set of growth figures partially explains why that confidence was shattered and why they look forward with some trepidation to the next reequipment cycle.

The effect of this experience is twofold. First, uncertainty has become an integral part of the investment decision calculus. In some corridors, analysts must be wondering if the airline industry has matured and therefore is likely to continue permanently on a slower growth path. But secondly, it will force decision-makers to be more conservative in making the assumptions which are necessary to derive traffic forecasts. For example, the heroic assumptions concerning the appeal of aircraft — such as those made to justify the 747 — are unlikely to be made, both because of the uncertain traffic growth and the nature of the next generation of aircraft.

In terms of the simple model above, assume time is introduced into the profit equation (see footnote 8). Thus, predictions of future growth become an integral part of the decision calculus. Focusing on the predictions for a single major market, assume that future traffic demand is specified by a probability distribution with an associated confidence interval. That is, before making a decision, airline decision-makers want to be, say, 99 percent sure that traffic will be within some range. The current uncertainty about the future, and the cyclical growth of the recent past will result in the range of confidence interval becoming wider.

To see the effect of this, refer to Figure 1. Here, two confidence intervals —A and B—are built around two predictions of traffic growth, both of which predict the same mean growth over the same time period. Confidence interval A refers to a prediction made during a period of stable growth; the variance of the distribution is considerably less than that of the distribution upon which

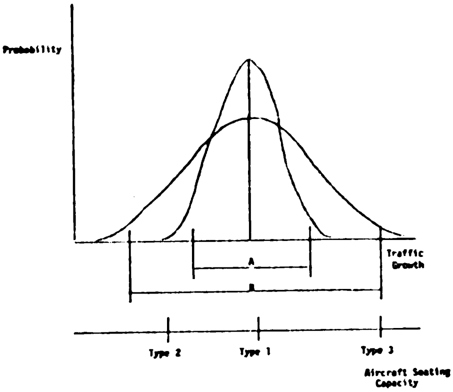

FIGURE 1

confidence interval B is made. The bottom line labeled "seating capacity," when compared to the distribution, illustrates the decision-making process of the airline. With confidence interval A, the decision-maker can be fairly confident that, ceteris paribus, aircraft Type 1 is appropriate for this route. But, if the decision-maker is faced with confidence interval B, his decision is less clear. All three aircraft types fall within the confidence interval. If faced with such a situation, the decision-maker might very well opt for aircraft Type 2 to protect against downside risk. Such a situation, if reported in several markets, might lead to at least some conservatism in investment decisions.

This conservatism should, in the aggregate, work to reduce the overcapacity in the industry, but uncertainty with respect to the long-term growth prospects of the industry may jeopardize its ability to obtain financing for the next reequipment cycle.

FINANCING

Doubt concerning both long-term and short-term growth, can be particularly detrimental to financing for two reasons. First, air transportation is a high fixed-cost industry. Once equipment is committed to operation, the objective is to keep aircraft flying and full; this phenomenon is termed "operating leverage." Cyclicality in air transportation profits is partly due to the high operating leverage which characterizes this industry. For example, break-even load factors can be calculated, given rates of utilization of aircraft and current regulatory policies. Table 1 illustrates the actual and break-even load factors of the domestic operations of TWA, together with its domestic profits for the period of 1971 to 1975.

As Table 1 illustrates, slight changes in actual load factors, or in breakeven load factors have tremendous impacts on corporate profits. These variations in profits may confound the airline's ability to plan and finance internally aircraft acquisitions. In addition, the investment community views such operational leverage as a risk element not present in other industries (e.g., manufacturing); as a result, the prospective investors must necessarily assign a risk premium to any debt let by airlines, especially those exhibiting a high degree of profit variability.

Second, the air transport industry is particularly characterized by financial leverage. This is the case because of the heavy reliance on debt instruments to finance equipment. Such financing occurs because the cost is low relative to equity, and because debt instruments—lease, bonds, convertibles, mortgages, conditional sales contracts, equipment trust certificates—can be matched to the service life and cash flows of the investment. While such financing is logical,

TABLE 1

LOAD FACTORS AND PROFITS OF TWA

(Domestic Operations)

	Actual Load Factor	Break-Even Load Factor	Domestic Profit (Millions)
1971	46.9%	48.0%	$–18.2
1972	52.2%	50.0%	$ 36.0
1973	50.4%	49.1%	$ 20.4
1974	53.0%	53.0%	$ 0.2
1975	53.4%	58.6%	$–99.2

TWA Annual Report, 1976.

the leverage engendered by such an investment policy can be tremendous. The interest and rental payments due on debt instruments must be satisfied before net income accrues to pay stockholders. Therefore, small changes in traffic or traffic growth can have large impacts on the firm's net revenues and therefore its ability to finance acquisitions internally. The condition of operational leverage itself is often aggravated by a need to finance short-term debt during temporary traffic downturns.

Aside from the risk premiums assigned by investors to airline issues because of operational and financial leverage, the successful sale of debt or equity always depends on investor confidence. The financial collapse of the Penn Central Railroad and other eastern railroads, together with the recent cash crises at Pan Am and TWA have soured investors on transportation issues. The outcome of these financial crises will, to a large extent, determine future investor confidence in the air transport industry. It should be noted that previous sales of airline equity were based on the tremendous growth rates which characterized the industry in the twenty-five years following World War II. Without such high growth, investments may be discouraged.

The effects of the finance-related factors identified above can now be summarized. All of them result in added risk premiums being assigned to aircraft acquisition programs. These premiums in turn have a direct impact on the ability of the airline industry to acquire aircraft. This is the case first because it is possible that interest rates—opportunity costs in the case of internal financing—on such acquisitions may be so high that they effectively foreclose the acquisition of some aircraft. Secondly, all of the factors described above tend to make investments in the airline industry less attractive than those in others, such as manufacturing. Third, the financial community has not been able to consistently analyze the risks involved in airline debt issues in the recent past. As a result, investor confidence has eroded, which will heavily influence the flow of capital funds to the airline industry.

The difficulties which are likely to surround the financing of the next reequipment cycle will work to reduce the overcapacity in the industry. The risks and uncertainties which surround investments in aircraft are likely to be further aggravated by the emerging regulatory climate.

REGULATION

The very fact that no clear direction has been given to the continued governmental interest in "reregulating," "deregulating," or "reforming the regulation of" the airline industry tends to have a dampening effect on the ability of the industry to obtain outside financing. Although a review of the variety of proposals and their likely effects on financing is beyond the scope of this paper, a single general comment is in order. The threat of regulatory reform forces investors to add still another risk premium to airline issues; such premiums make investments in the industry less attractive than issues from other industries. Perhaps more importantly, if regulations led to freer market entry, the impacts would likely be felt disproportionately by the major trunk carriers whose markets are looked on with the most envy by other carriers. Thus, investor doubts concerning changes in regulations center around the viability of the trunks who, coincidentally, are the major market for new aircraft. Thus, ironically, the doubts concerning regulation may serve to reduce the overcapacity in the industry partly caused by regulation.

NEW DETERMINANTS OF INVESTMENT

The two new factors which impinge on airline investment decisions are energy and the environment. Neither has been a factor in previous reequipment cycles, but one (or both) may become the most important factor in airline acquisition decisions.

ENERGY

It is, of course, the price of energy which will determine the viability of current and future aircraft acquisition decisions. Significant increases in the price of aviation fuels could force substantial changes in the structure of the industry. (For example, further liberalization of charter rules and reductions in scheduled service might emerge as a viable regulatory policy option as fuel prices rise.) But beyond mere speculation concerning structural changes in the industry, increases in real fuel prices and the resulting increased yields will have a dampening effect on passenger demand. If decision-makers discount traffic forecasts for possible fuel price increases, this too should have a dampening effect on over-capacity in the industry.

THE ENVIRONMENT

Given the financial position of the industry today and the variety of uncertainties already discussed, it is unlikely that the reequipment cycle would progress as fast as it is likely to, except for the schedule for noise reductions mandated under FAR, Part 36. The de facto obsolescence of aircraft resulting from these regulations has effectively determined the need to replace certain aircraft. Curiously, costs of manufacturing the next generation of aircraft will also be higher, as a result of these regulations. Thus, the mandated reductions in noise will result in upward shifts in both the demand and supply curves for aircraft. Prices will, ceteris paribus, be higher, but the impact on the number of aircraft is less clear.

CONCLUSION

It seems likely that the increased exposure to uncertainty and risk in future airline investment decisions will result in a reduction in over-capacity in the industry. But perhaps it is more appropriate to conclude that, given the above partial equilibrium analysis, over-capacity in the airline industry will be lower than it otherwise would have been in the absence of the changing and newly emerging factors in airline investment decision function(s).

FOOTNOTES

1 See for example Almarin Phillips, **Technology and Market Structure: A Study of the Aircraft Industry** (Lexington, Mass. D. C. Heath and Co., 1971) or R. E. Miller and D. Sumers, **The Technical Development of Modern Aviation**, (New York: Praaeger Publishers, 1970).

2 See those mentioned in footnote 1, and others, including Aaron J. Gellman, **The Effect of Regulation on Aircraft Choice**, Ph.D. dissertation, Massachusetts Institute of Technology, 1968; Richard Caves, **Air Transport and Its Regulation**, Cambridge: Harvard University Press, 1962.

3 William E. Fruhan, "**The Flight For Competitive Advantage: A Study of the United States Domestic Trunk Air Carrier**," Harvard University, 1972.

4 Joseph E. Yance, "Non-Price Competition in Jet Aircraft Capacity," **Journal of Industrial Economics**, Vol. 21, No. 1, 11/72, pp. 55-71.

5 CAB, **Aircraft Operating Cost and Performance Report**, 1965.

6 See, for example: Richard Caves, **Air Transport and Its Regulators**, Cambridge: Harvard University Press, p. 314:

> "Substantial point-to-point competition makes it impossible for a carrier to stand equipment inferiority for very long in the absence of price differentials."

It should also be noted that aircraft manufacturers probably must surpass the earlier accomplishments of their competition in order to capture significant shares of markets. For example, while many consider the L-1011 technically superior to the DC-10, the earlier introduction of the latter will probably preclude the full recovery of program costs for the L-1011.

7 Lawrence White, "Quality Variations When Prices are Regulated," **Bell Journal of Economics and Management**, Autumn, 1972.

8 For simplicity, the analysis ignores time; in strictest terms and in equilibrium, the present value of added net revenues of the last aircraft bought should equal the cost of amortizing it.