Measuring the Degrees of Operating, Financial and Combined Leverage for the Major U.S. Air Carriers: 1979-1995

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I. INTRODUCTION

Although by some measures the airline industry is doing quite well,[1]

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1. A number of carriers have reported record or near record profits over the past two

the high-risk nature of the industry has long been apparent.[2] Since 1982, at least 123 U.S. air-carriers have either failed or have lost their certification.[3] Given the cyclical nature of airline revenues, the apparent prosperity of the airlines in recent years may be attributed more to the robustness of the U.S. economy than to any significant change in the basic nature of the industry.

The operating and financial cost structures of the airline industry's members, as well as the industry's cyclical vulnerability, adversely influences the long-term stability of the airline industry.[4] On the operating side, the pressures of an intensely competitive marketplace and the inherently high fixed-cost structure of the industry pose a continual threat to industry stability. On the financial side, the highly-leveraged nature of airline financing leaves the industry particularly vulnerable to increases in interest rates and/or economic downturns. Moreover, the huge demand for the funds necessary to replace aging equipment will exacerbate the problems facing the industry over the next decade.

This paper examines some basic risk measures which may be utilized to assess risk in the airline industry.[5] Values for these risk measures have been computed for the eight major U.S. air carriers over the period 1979-

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years. *See* Value Line Investment Survey, Vol. 52, No. 40 (June 20, 1997) at 251. Much of the lift behind these profits is due to the high leverage present in the industry, as well as to low interest rates and stable fuel prices. Should a recession occur, or should interest rates and fuel costs increase, these profits will probably dissipate rather quickly.

2. Several prior studies have established the comparatively high-risk nature of the airline industry. *See generally* Richard D. Gritta, *An Unresolved Issue in Setting the Cost of Capital to the U.S. Domestic Airlines*, 31 J. AIR L. & COM. 65 (1975) (comparing the risk levels of major air carriers to a sample of sixteen subgroups of industrial firms, which total 74 companies, and a sample of natural gas, telephone and electric utilities, and finding that air carriers as a group exhibited significantly higher levels of risk); Richard D. Gritta & Bahram Adrangi, *Risks in the U.S. Airline Industry: Pre and Post Deregulation*, 26 J. TRANS. RES. F. 434, 434-40 (1985) (determining that risks for the airline industry actually increased after deregulation). A more recent study confirmed the high-risk nature of the industry by comparing air carrier risk to risk levels for a large random sample of industrial groups. Richard D. Gritta et al., *The Causes and Effects of Business and Financial Risk in Air Transportation: Operating and Financial Leverage and the Volatility in Carrier Rates of Return*, 6 J. TRANSP. MGMT. 127 (1994).

3. PAUL STEPHEN DEMPSEY & LARRY GESELL, AIRLINE MANAGEMENT: STRATEGIES FOR THE 21ST CENTURY, citing THE AVIATION & AEROSPACE ALMANAC 102-03 (1995). Some argue that deregulation has had a negative effect on the financial health of the industry. *See generally* Melvin A. Brenner, *Airline Deregulation-A Case Study in Public Policy Failure*, 16 TRANSP. L J. 179 (1988); Paul Stephen Dempsey, *Airlines in Turbulence: Strategies for Survival*, 23 TRANSP. L J. 15 (1995).

4. Frederick was one of the first to discuss the cost structure of the air carriers and its effects on risk. *See* JOHN H. FREDERICK, COMMERCIAL AIR TRANSPORTATION 331-32 (4th ed. 1961). The cyclical nature of the industry has been demonstrated in several studies. *See* Animesh Ghosal, *Price Elasticity of Demand for Air Passenger Service: Some Additional Evidence*, 20 TRANSP. J. 93-96 (1981); J.M. Jung & E.T. Fugii, *Price Elasticity of Demand for Air Travel*, 10 J. TRANSP. ECON. & POL'Y 257-62 (1976).

5. Richard D. Gritta, *Risks from Operating and Financial Leverage in the U.S. Domestic*

1995 and support the proposition that the airlines operate within a particularly high-risk environment. By highlighting the effects of leverage and the differences in carrier financial strategies, this paper argues that high carrier debt burdens are inappropriate given the volatility of the industry.

Section II identifies the generic risks common among nearly every business enterprise and reviews a set of economic measures intended to gauge these risks. Section III applies these measures to the air transportation industry and provides results for all major U.S. air carriers for the years 1979-1995. Section IV describes the implications for the industry as it prepares to replace aging fleets during the next decade. Finally, section V provides several solutions to the problems the industry faces.

II. Defining and Measuring Industry Risks

All firms face three types of risk: business risk, financial risk and combined risk.[6] "Business risk" can be defined as the variability in a firm's operating profit over time (often referred to as "Earnings Before Interest and Taxes," or "EBIT"). This type of risk is generally attributable to the inherent nature of a firm's operations and the environment within which it operates. Moreover, a firm's cost structure, product demand characteristics and intra-industry competitive position drive this type of risk. Some companies may face high business risk solely because of external (and therefore largely uncontrollable) factors such as high-fixed costs, the cyclical nature of its business, government regulation and intense competition.[7] However, high business risk can also result from poor cost controls, low productivity or pricing practices which dilute revenues. The airline industry suffers a high business risk on virtually all these counts.

Financial risk is generally defined as the added variability in earnings available to a firm's common shareholders due to the use of long-term debt to finance the acquisition of assets. Financial risk often represents the increased probability of insolvency that comes with excessive debt finance because interest on debt *must* be paid (unlike common stock dividends, which are paid at management's discretion). High financial risk may indicate that high interest charges are overwhelming a business enterprise, forcing it in some cases to seek court protection. Unlike business

Airline Industry, Proceedings of the 37th Annual Meeting of the American Society of Traffic and Transportation 276-91 (1982). This paper is an early forerunner of this current study.

6. These three risk categories are commonly identified in financial theory. *See generally* R. Charles Moyer et al., Contemporary Financial Management 319-53 (6th ed.)

7. Brigham has noted that airlines must invest heavily in fixed assets, which result in high operating leverage. This situation is, therefore, outside the control of management. *See* Eugene F. Brigham & Louis C. Gapenski, Intermediate Financial Management 391 (4th ed. 1993).

risk, financial risk is not primarily the product of the environment within which a company operates, but rather results directly from a firm's conscious decision to use financial leverage (i.e., long-term debt or preferred stock) instead of issuing common stock to raise funds.

Finally, "combined," or "total" risk, as the name suggests, refers to the risk that the interaction of both operating and financial risk creates. The interaction of the two risk types produces a multiplicative, rather than an additive, effect. As discussed below, the impact of the combined effect can be extremely powerful.

A. Measuring Business Risk

A firm's degree of operating leverage (DOL) constitutes one of the principal measures of a firm's business risk.[8] Operating leverage generally refers to the firm's incurring fixed operating costs. As a general rule, high fixed costs create more unstable DOLs. An elasticity measure borrowed from microeconomic theory, DOL actually measures the responsiveness of operating profits (EBIT) to changes in operating revenue. In other words, DOL measures the X% change in operating profits that would be induced by a 1% change in operating revenues. The expression below illustrates the calculation:

$$DOL = \frac{R-V}{R-V-F} \quad [9]$$

where R = operating revenue
V = variable costs
F = fixed costs

The sign and magnitude of DOL are both important indicators of risk.

To illustrate, consider a situation in which a firm's operating revenues (R) are $500, its variable costs (V) are $100 and its fixed costs (F) are $150. In this case:

8. Moyer et. al., *supra* note 6, at 318-28.

9. As an elasticity measure, DOL = % change in operating profits (EBIT) divided by change in operating revenues (OR). Operating revenues can be defined as pq (price per unit of output *times* output) and variable costs (V) equal vq (variable cost per unit *times* output). Thus, if the values of p and v remain constant, and fixed costs (F), by definition, are constant:

$$DOL = \frac{\%\Delta EBIT}{\%\Delta OR} = \frac{\frac{\Delta q(p-v)}{q(p-v)-F}}{\frac{\Delta qp}{qp}} = \frac{\Delta q(p-v)}{q(p-v)-F} \times \frac{q}{\Delta q} = \frac{q(p-v)}{q(p-v)-F} = \frac{R-V}{R-V-F}$$

$$DOL = \frac{500-100}{500-100-150} = +1.6$$

Since revenues (R) exceed the sum of variable plus fixed costs (V+F) in this situation, the firm acts above its operating break-even point and DOL is positive. The positive DOL indicates that as R increases, operating profits will increase (and vice versa). In this case, a 1% increase in revenues will produce a 1.6% increase in operating profits. Similarly, a 1% decrease in revenues will produce a 1.6% decrease in operating profits.[10] The relatively small positive value for DOL indicates a relatively low business risk (i.e., low variability in operating profit), since changes in revenue will induce relatively small changes in operating profits. In contrast, had fixed costs (F) been higher relative to (R-V), say $350 rather than $150, DOL would increase (to +8.0), indicating a significantly higher level of business risk.[11]

Should costs (V + F) exceed operating revenues, operating profit is negative and the picture changes. Suppose, for example, R=$500, V= $400 and F=$110. Here the firm acts below its operating break-even point:

$$DOL = \frac{500-400}{500-400-110} = -10$$

This implies that a 1% change in operating revenues will induce a 10% change in operating profits or, more accurately, operating losses. The negative sign indicates that when revenues increase, operating losses will decrease (and vice versa). The relatively large absolute value for DOL implies a relatively high degree of variability in operating profits (losses), which can be dangerous since the firm operates below its break-even point.

However, such large negative values can actually be interpreted as less serious than very low negative numbers, since large absolute values indicate that current losses are relatively small and that a small increase in operating revenues can be expected to cut deeply into operating losses. Had fixed costs (F) been larger relative to (R – V), say $600 rather than $110, DOL would have remained negative — again indicating an operating loss — but its absolute value would have been substantially smaller. (In this case, DOL would have been –.2). This smaller absolute value would be especially alarming since (1) it reflects the large size of current

10. In general, when R exceeds the sum of (V+F), DOL will take on a value between +1 and $+\infty$.

11. If the firm has no fixed costs, that is, if F = 0, it has no operating leverage. Thus business risk would be low and DOL would equal +1.0.

operating losses and (2) it implies that positive changes in operating revenues will have only a minimal effect on reducing those losses.[12]

Although fixed costs are generally seen as the key to determining the value of DOL, inefficient management policies affecting variable costs or gross revenues can also contribute to high business risk. In the airline industry, for example, factors such as poor cost controls or inefficiencies in a carrier's route structure can produce unfavorable DOLs. Reduced revenues caused by aggressive fare wars may have a similar effect.

B. Measuring Financial Risk

A firm's degree of financial leverage (DFL) can measure that firm's financial risk. This interest-driven measure reflects the responsiveness of net profit to changes in operating profit (EBIT). More specifically, if I = interest, then

$$\text{DFL} = \frac{\text{Operating Profit}}{\text{Operating Profit} - \text{I}}$$

Since operating profit equals R-V-F (Revenue – Variable Cost – Fixed Cost), the expression can be rewritten as:

$$\boxed{\text{DFL} = \frac{\text{R}-\text{V}-\text{F}}{(\text{R}-\text{V}-\text{F})-\text{I}}} \quad [13]$$

In this latter form, the roles of both F and I can readily be seen.

Like DOL, DFL is an elasticity measure. Here DFL measures the X% change in net profit (R-V-F-I) that would be produced by a 1% change in operating profits. Since tax rates remain relatively constant, net profits before and after taxes will vary in unison. As in the case of DOL, both the sign and the magnitude of DFL are significant.

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12. Negative DOL values will be between 0 and $-\infty$.

13. As an elasticity measure, DFL = % change in net profit (NP) divided by a % change in operating profits (EBIT). Net profits can be defined as q(p-v)-F-I; operating profits (EBIT) can be defined as q(p-v)-F . Thus, if the values of p and v remain constant, and fixed costs (F), by definition, are constant, then:

$$\text{DFL} = \frac{\%\Delta NP}{\%\Delta EBIT} = \frac{\dfrac{\Delta NP}{NP}}{\dfrac{\Delta EBIT}{EBIT}}$$

$$\text{DFL} = \frac{\dfrac{\Delta q(p-v)}{q(p-v)-F-I}}{\dfrac{\Delta q(p-v)}{q(p-v)-F}} = \frac{\Delta q(p-v)}{q(p-v)-F-I} \times \frac{q(p-v)-F}{\Delta q(p-v)} = \frac{q(p-v)-F}{q(p-v)-F-I} = \frac{R-V-F}{R-V-F-I}$$

To illustrate, suppose

Operating Profit = \$90 (with R=500 V=400 and F=10)

and

Interest (I) = \$10

then

$$DFL = \frac{90}{90-10} = +1.125$$

This indicates that a 1% change in operating profit will produce a 1.125% change in net profit. The positive sign reflects that the firm acts above its financial breakeven point (i.e., operating profits exceed interest). The positive sign also indicates that when operating profits increase, net profits will increase. Consequently, when operating profits decrease, net profits will decrease. The relatively small value of DFL here means that (1) net profit is relatively large (relative to operating profit) and (2) variability in net profit (i.e., risk) is relatively small.

Had interest been higher, the positive value of DFL would increase (so long as interest did not exceed operating profit). For example, if interest (I) were \$88, DFL would equal +45. A 1% change in operating profits here would produce a 45% change in net profit. The firm would still operate above financial breakeven point (hence the plus sign), but net profits would vary significantly (risk).[14]

When interest exceeds operating profit, the firm shows a net loss and DFL is negative. This negative DFL means that an increase in operating profit will lead to a decrease in the firm's net loss and vice versa. As in the case of negative DOLs, small absolute values for negative DFLs are especially serious since they indicate (1) large net losses for the firm and (2) a lack of net loss responsiveness to improvements in operating profits.[15]

C. Measuring Combined Risk

A firm's combined risk — the product of its business and financial risks — can be measured by its degree of combined leverage (DCL). The multiplicative effect of business and financial risks in the calculation of DCL means that the core causes of risk — interest and fixed costs — magnify total risk to a degree that exceeds their simple sum. Similar to the effect of levers in physics, it is as though one lever (interest) magnifies what another lever (fixed costs) has already magnified. Specifically:

14. For positive DFLs, values will range from +1 (when the firm is debt-free, i.e., when I= 0) to $+\infty$ (when Interest = Operating Profit).

15. Negative DFL values will range from $-\infty$ to 0. It should also be noted that if operating profits are negative, DFL will be reported as negative irrespective of the value of I.

$$DCL = DOL \times DFL$$

$$= \frac{R-V}{R-V-F} \times \frac{R-V-F}{R-V-F-I}$$

$$= \frac{R-V}{R-V-F-I}$$

As defined here, DCL measures the X% change in net profit that a 1% change in operating revenues would produce.

When revenue (R) exceeds the total costs (V+F+I), the firm operates above its total break-even point and DCL will be positive. In such a case, smaller DCL values indicate relatively low combined risk since fixed costs and interest would be relatively low when compared to revenue. In the extreme, if DCL is +1, combined risk is minimal since fixed costs and interest would necessarily be 0.

When total costs (V + F + I) exceed revenue, the firm operates below its combined breakeven point and DCL will be negative. Low absolute values for DCL cause special concern here since low absolute values indicate that (1) losses are large and (2) responsiveness to improvements in revenue will be sluggish. Insolvency is more likely and the firm has a long way to go to restore profitability.[16]

Critically, the multiplicative interaction that produces combined risk highlights the danger of employing debt finance when a company faces a high-risk DOL. To illustrate, assume two companies face the same large positive DOL, meaning that a very small decline in revenue can precipitate a very large decrease in net profits. In this case, assume DOL for both companies is +10. Company A, perceiving the business risk it faces and wary of any downturn in the economy, decides to use no debt in its capital structure, and thus has a DFL of +1. Its resulting DCL is 10 x 1 = +10. Company B, on the other hand, chooses to ignore the incremental risk associated with debt financing and, as the result of interest on its debt, faces a DFL of +4. DCL for this firm rises to a more dangerous +40 (10 x 4). Should the industry experience a slowdown in activity or face a recession, Company B clearly faces the greater risk. A 5% reduction in revenue will cause a 50% reduction in Company A's net profits (5% x 10), a serious enough drop, but B's net profits will plummet by 200% (5% x40).

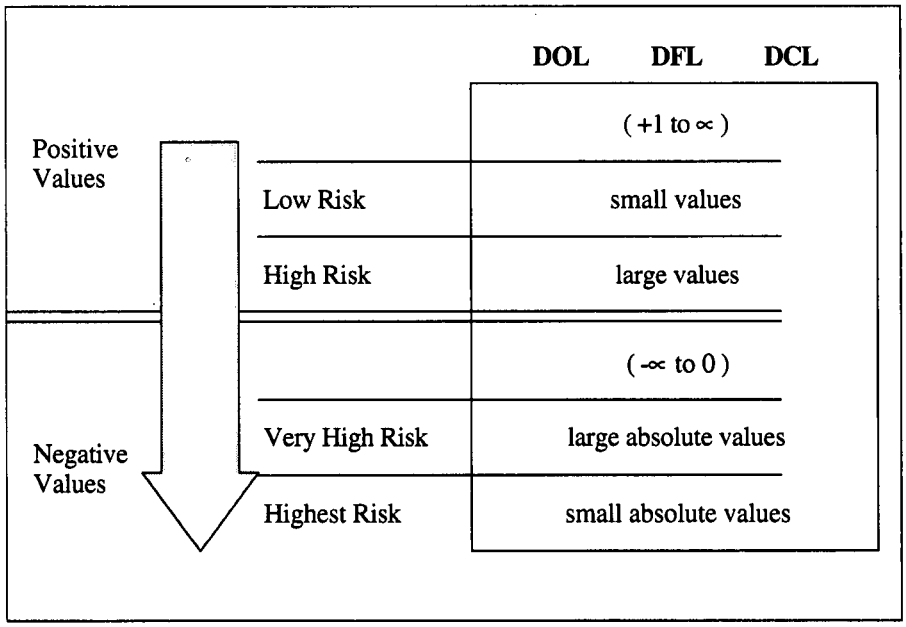
The situation grows even worse in cases where DCL values are negative with small absolute values, especially where such conditions persist over a long period of time. (As suggested earlier, this is because the base

16. If either DOL is negative or DFL is negative, or if *both* DOL and DFL are negative, DCL will be reported as negative.

of losses is so large that the financial solvency of the enterprise in the long run is severely threatened).

Exhibit I below should help clarify the discussion. As the arrow indicates, the direction of increasing risk flows down the chart.

EXHIBIT I: ORDERING LEVELS OF RISK



Because of the multiplicative effect of business and financial risks, most companies and industries try to balance risk. That is, a company high in business risk will tend to avoid significant long term debt finance. A company low in business risk will be more likely to use debt finance since it will tend not to threaten the firm's basic stability.[17]

III. AIR CARRIER RISK ANALYSIS

Values for the leverage measures described in Section II were calculated for the eight major U.S. air carriers for the years 1979-1995, a period that spans nearly the entire post-deregulation history of the airline industry. Exhibit II shows the DOL, DFL, and DCL results. (Note: In

17. The need to balance business and financial risk is a principle advanced by virtually every finance textbook. *See generally* Brigham & Gapenski, *supra* note 7; MOYER ET AL, *supra* note 6. Richard D. Gritta found this to be true in an empirical study contrasting levels of business, financial and total risk in the airline industry with risk levels in other industries. Gritta, *supra* note 2.

EXHIBIT II: DOL, DFL AND DCL VALUES BY CARRIER 1979-1995

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
American																	
DOL	143.4	-6.1	21.4	-54.8	5.7	5.0	14.6	5.1	5.8	4.2	5.0	50.0	217.7	-54.4	9.0	6.4	6.2
DFL	-0.1	4.9	-0.5	-0.1	2.5	1.6	-6.5	1.6	1.6	1.3	1.4	-0.4	-0.1	-0.2	3.6	2.0	2.4
DCL	-9.5	-29.9	-9.9	-5.9	14.6	8.1	-95.3	8.0	9.5	5.4	7.1	-17.9	-11.9	-9.1	32.7	12.8	14.6
Continental																	
DOL	-9.6	-2.7	-3.5	-3.9	-1.4	4.2	3.9	5.0	43.6	16.8	10.6	-6.0	-5.4	-7.1	-33.5	-16.5	7.0
DFL	-0.4	-0.6	-0.5	-0.5	-0.7	3.8	1.9	2.8	-0.1	-0.4	-1.7	-0.5	-0.7	-0.6	-0.2	-0.3	4.0
DCL	-4.0	-1.6	-1.7	-1.9	-0.9	15.9	7.3	14.0	-5.9	-7.1	-18.1	-3.1	-3.6	-4.4	-7.6	-5.1	27.8
Delta																	
DOL	5.9	5.3	10.3	-9.9	-18.3	5.3	9.3	6.8	4.7	4.9	4.7	-10.1	-10.7	-3.5	-13.2	-18.1	4.5
DFL	1.2	1.2	1.7	-0.5	-0.3	1.7	1.3	1.5	1.3	1.2	1.1	-0.7	-0.6	-0.8	-0.5	-0.4	1.3
DCL	6.9	6.2	17.7	-5.2	-6.1	8.8	12.3	9.9	6.0	5.8	5.2	-7.2	-6.5	2.8	-6.8	-8.0	5.9
Northwest																	
DOL	5.9	-14.4	205.0	-58.0	9.3	8.4	10.8	8.5	9.0	10.6	8.3	-16.1	-41.9	-34.0	9.5	4.2	3.5
DFL	1.2	-0.6	-0.2	-0.5	1.1	1.1	1.1	1.5	1.6	1.4	1.2	-0.6	-0.2	-0.6	2.8	1.3	1.4
DCL	7.0	-8.0	-34.8	-27.5	10.6	9.4	12.0	12.5	14.7	15.1	10.4	-9.0	-10.0	-21.5	26.3	5.7	4.7
Southwest																	
DOL	1.9	1.8	2.0	2.8	2.5	2.7	3.2	3.2	N/A	2.3	4.2	11.1	4.4	3.7	3.2	3.5	4.0
DFL	1.5	1.2	1.3	1.2	1.2	1.3	1.4	1.5	N/A	1.5	1.5	1.6	3.4	1.5	1.2	1.2	1.2
DCL	2.8	2.2	2.5	3.5	3.1	3.5	4.5	4.8	N/A	3.5	6.4	18.3	15.0	5.5	4.0	4.3	4.9
TWA																	
DOL	-13.8	-19.2	211.7	-7.0	-12.0	13.4	-3.6	-11.6	6.4	6.3	59.4	-0.3	-1.9	-0.4	154.9	-4.8	27.1
DFL	-0.4	-0.3	0.0	-0.5	-0.4	-1.7	-0.3	-0.3	547.7	-3.6	-0.1	-0.3	-0.5	-0.8	-0.7	-0.6	-0.4
DCL	-5.3	-5.5	-7.6	-3.4	-4.3	-23.2	-1.1	-3.0	3512.8	-22.7	-3.9	-0.1	-1.0	-0.3	-103.5	-2.6	-9.6
United																	
DOL	-2.4	-13.0	-6.3	-16.6	10.0	3.8	-3.6	-206.2	18.9	5.6	8.5	-72.8	-8.2	-10.0	18.5	9.2	6.2
DFL	-0.8	-0.4	-0.6	-0.3	-5.9	1.3	-0.7	-0.1	4.6	1.4	1.6	-0.3	-0.7	-0.6	-10.4	2.9	1.7
DCL	-1.9	-5.2	-3.5	-4.4	-59.6	4.9	-2.6	-12.5	86.3	8.1	13.4	-19.8	-6.0	-6.3	-192.3	26.8	10.5
USAir																	
DOL	3.8	3.0	4.9	4.4	3.3	2.7	3.4	3.7	2.9	6.2	-4.5	-2.1	-7.3	-3.7	-13.2	-3.1	9.6
DFL	1.4	1.3	1.6	1.6	1.3	1.2	1.3	1.3	1.2	1.6	-0.7	-0.8	-0.5	-0.7	-0.4	-0.6	-3.9
DCL	5.3	4.0	7.9	7.2	4.3	3.2	4.4	4.9	3.3	10.2	-3.2	-1.7	-3.9	-2.4	-4.9	-2.0	-38.0

* Source: Table values computed using data from *Air Carrier Financial Statistics*

the computation of these values, variable costs (V) are defined as the sum of flying operations, maintenance, passenger service, and air traffic costs. Fixed costs (F) are the summation of promotion and sales expenses, general and administrative costs, depreciation and amortization expenses, and various transportation related costs).[18]

With one exception, the carriers face a difficult and volatile financial situation.[19]

A. Years of Negative Leverage Values

Exhibit III shows the number of years in which each of the carriers in the study experienced negative DOL, DFL, and/or DCL values. Half of these carriers experienced negative DCLs in nearly 50% of the years studied. (Importantly, negative DFLs produce this result in most of the cases.)[20] Carriers generally recognized as financially unstable do stand out. Continental (CAL) and Trans World Airlines (TWA) lead the group with thirteen and sixteen years of negative DCLs, respectively. These carriers also experienced frequent periods of negative operating leverage. Both carriers show ten years of negative DOLs. (Both carriers have ex-

18. The accounts used are the standard account lines presented in the publication, *Air Carrier Financial Statistics*. This publication was formerly published by the Civil Aeronautics Board (CAB) and is now produced by the Transportation Systems Center. One point must be noted here: To the extent that some airline variable costs, such as fuel, are "sticky" or "constant" in the economic lexicon (or as accountants would say are step-variable in nature), the analysis of the DOL presented in this paper actually *understates* the true level of risk in the airline industry. Caves, the prominent airline economist, argued that to a large extent, costs which might appear to be structurally quite variable, may be in fact far less so in the airline industry. As traffic declines, classical variable costs such as fuel, cannot be cut immediately in response. Hence, they behave in a "sticky" manner, increasing operating leverage. *See* Richard E. Caves, Air Transport and Its Regulators 82 (1962).

19. As described earlier, the most severe conditions a carrier can face are (1) small negative DOLs, DFLs, and DCLs, the latter being the most severe and (2) volatile DOLs, DFLs, and DCLs over time. According to the discussion in section III, there are several reasons for this. First, very small negative DCLs indicate considerable financial distress since net profits (EBIT-I) are strongly negative and the carrier could default on loan payments (interest, principal, and lease obligations). Several bankruptcy studies clearly demonstrate the effect of excess leverage on carrier solvency. *See generally* Richard D. Gritta, *Bankruptcy Risks Facing the Major U.S. Airlines*, 48 J. Air L & Com. 89 (1982) (predicting the demise of both Braniff and CAL before the fact); Richard D. Gritta et al., *A New Approach to Forecasting Financial Distress in Air Transportation: The AIRSCORE Model*, 31 J. Transp. Res. F. 371 (1991); Richard D. Gritta, *Solvency and Financial Stress in Air Transportation*, 6 Transp. L. J. 139 (1974). Second, volatility (extreme variability) is abhorrent to stockholders and other investors, unless compensated by commensurably higher rates of return. Investors, ex-post, must perceive that they will be rewarded for assuming risk. Ex-ante, their expectations may not be fulfilled. *See* Charles P. Jones, Investments: Analysis and Management 149-77 (5th ed. 1995).

20. As described earlier, if either DOL or DFL is negative, then DCL must also be negative since DCL is the product of the two values. Less obviously, should *both* DOL and DFL be negative, DCL will also be reported as negative. In every case, the absolute values of DOL and DFL are multiplied, with the sign applied appropriately to the resulting product.

EXHIBIT III: THE NUMBER OF YEARS OF NEGATIVE LEVERAGE EXPERIENCED BY EACH OF THE AIRLINES IN THE STUDY

	DCL	DOL	DFL
American	8	3	7
Continental	13	10	13
Delta	7	7	7
Northwest	6	5	6
Southwest	0	0	0
TWA	16	10	15
United	11	9	11
USAir	7	6	7

perienced liquidity crises and sought court protection on more than one occasion).

Notably, several carriers reputed to be strong are seriously impacted, such as American, Delta, and United. American Airlines showed only three years of negative DOLs, but its financial policies resulted in seven years of negative DFLs. This illustrates the peculiarity of the industry in the sense that its stronger members, at least in terms of market power, still face significant risk.

Among the other carriers, Northwest Airlines (NWA) serves as a particularly interesting case. NWA followed conservative financial strategies in the early to mid-1980s.[21] In fact, in 1984, the carrier reported a 0% long-term debt load. (This marked the first time in modern aviation history that a major carrier experienced no debt). As Exhibit II demonstrates, the airline performed strongly from 1983 to 1988, or until the leveraged buyout (LBO) in 1988 damaged its strong balance sheet and nearly forced the airline into insolvency.[22]

USAIR also provides an interesting case. Although USAIR achieved efficient performance over the period 1979-1988, it became embroiled in the increasingly competitive industry, thereby increasing its reliance on debt to finance expansion. Consequently, USAIR has experienced severe financial problems. All of its negative DCLs occurred in the years 1989-1995.

In general, the data suggest an alarming pattern of reliance on debt

21. For a complete discussion of carrier financial strategies, with NWA used as a model, see Richard D. Gritta, *The Effects on Financial Leverage on Air Carrier Earnings*, 8 FIN. MGMT 53, 53-60 (1979).

22. For the damage done by LBOs in this industry, see generally Michele M. Jochner, *The Detrimental Effects of Hostile Takeovers, Leveraged Buyouts, and Excessive Debt in on the Airline Industry*, 19 TRANSP. L. J. 219 (1990); William Jordan, *Problems Stemming for Airline Mergers and Acquisition*, 27 TRANSP. J. 9 (1988).

finance in the face of significant business risk. Southwest Airlines (SWA) constitutes an important exception. With respect to business risk, SWA stands as the one carrier in the study that seems to have consistently employed a conservative operating strategy. Its consistently favorable DOLs reflect SWA's emphasis on "point-to-point" service, in contrast to the "hub-and-spoke" routing of most of the other carriers, and its simplified fleet structure.[23] In addition, SWA's reasoned financial strategies appear to have contributed to its position as a model of long-run stability. The airline has experienced seventeen consecutive years of positive and relatively low DOL, DFL and DCL values.

B. Industry Volatility

An examination of Exhibit IV illustrates the issue of volatility. The exhibit demonstrates the extremes of each measure of risk for the eight carriers in the study.

Exhibit IV: Extreme Values for Leverage Measures 1979-1995

	American	Continental	Delta	Northwest	Southwest	TWA	United	USAIR
DOL								
Max +	217.74	43.62	10.35	204.97	11.1	211.69	18.49	9.62
Max –	-54.76	-33.49	-18.34	-58.04	none	-19.19	-206.17	-13.23
Min +	6.2	3.91	4.49	3.47	1.78	6.34	3.8	2.72
Min –	-6.12	-1.39	-3.47	-14.43	none	-0.34	-2.41	-2.12
DFL								
Max +	4.89	3.96	1.71	2.78	3.43	547.69	4.57	1.63
Max –	-6.55	-1.71	-0.8	-0.63	none	-3.59	-10.4	-3.95
Min +	1.28	1.86	1.11	1.11	1.22	547.69	1.3	1.17
Min –	-0.05	-0.13	-0.33	-0.17	none	-0.04	-0.06	-0.37
DCL								
Max +	32.67	27.77	17.73	26.31	18.27	3512.83	86.29	10.19
Max –	-95.33	-18.14	-8.03	-34.78	none	-103.52	-192.28	-38
Min +	5.43	7.26	2.76	4.69	2.19	3512.83	4.93	3.18
Min –	-5.88	-0.95	-5.21	-8.05	none	-0.07	-1.85	-1.69

Several of the dramatic extremes shown in Exhibit IV underscore the volatile nature of the industry. For instance, TWA's maximum positive DCL of +3512 serves as an especially eye-catching example. Such extraordinarily large positive values are typically produced when the base of profits is so small that a relatively small *absolute* change in value represents a very large *percentage* change.

Exhibit IV also reveals a large number of cases in which negative

23. The key to lower costs is to maximize aircraft utilization, employ "point-to-point" service, not the "hub-and-spoke" system, and minimize the numbers of types of aircraft in the carrier's fleet. SWA has perfected this strategy. For a discussion of operating strategies in a deregulated environment and their effectiveness, see Dempsey, *supra* note 3, at 35-41.

levels of DFL are alarmingly small (in absolute value) — an indication that these carriers have followed financial strategies which are inappropriate in an industry characterized by high business risk.[24] The minimum negative levels of DCL are particularly unfavorable for CAL (DCL=-.95) and TWA (DCL=-.07). SWA once again stands out as the exception. Its operating and financial strategies have kept its leverage measures in the low positive range (i.e., the lowest risk range) for every year of the study.

IV. The Future: Increased Need for Funds, Decreased Financing Flexibility

The airlines face a difficult future. Although 1996-1997 profits appear substantial, the financial excesses of the past have weakened the carriers. In all likelihood, more than a few strong years will be required to establish a fair degree of stability and strengthen balance sheets enough to make a real difference.[25] Significantly, the industry will possess less flexibility in securing new funds at a time when the requirement for funds will increase dramatically.

The need to replace aging aircraft will perhaps present the industry's greatest challenge. Exhibit V illustrates the average age of aircraft for the eight major carriers.

Exhibit V: U.S. Airline Average Fleet Ages (in years)[26]

	1990	1994	1996
American	9.6	7.6	9.0
Continental	12.6	14.7	14.3
Delta	8.9	10.1	11.5
Northwest	15.5	16.8	19.2
Southwest	5.8	7.5	7.9
TWA	16.3	18.0	19.0
United	12.3	10.0	10.9
USAir	8.9	10.6	12.9

As shown, the average age of many of the fleets has steadily in-

24. As already discussed, very small negative values often result when the base of losses is so large that a significant absolute increase in revenue or profits has little effect in *percentage* terms.

25. And it cannot be assumed that industry profits are going to continue to grow and/or remain high. In the mid-1990s, fuel costs and interest rates were low and stable, and labor had made many concessions to the carriers in response to the losses of the early part of the decade. There is no guarantee this situation will continue. Furthermore, given the tremendous built up operating and financial leverage, an economic downturn will hurt just as much as the record economic growth period has helped.

26. Julius Maldutis, "The U.S. Airline Industry, 1996-2000E-Year-End Update: Aircraft Fleet Analysis," Salomon Brothers, April 8, 1997, figure 5.

creased. Not surprisingly, the weaker, more financially distressed carriers such as TWA, CAL, NWA, and USAIR have tended to defer the purchase of new and more efficient jets. In addition to adversely affecting the efficiency of these airlines, such actions have also created concern in the minds of the flying public, as the past several years have realized a surfacing of the issues of safety and airframe age.[27] It seems clear that these carriers must reverse this trend in the near future.

The cost of refurbishing fleets while providing for other needs will prove enormous. While the world's airlines spent $147 billion in the 1980s, one Wall Street analyst estimates that the industry will need to spend over $815 billion by the year 2000.[28] Boeing has projected that the world's carriers will need about 16,000 aircraft valued at $1.1 trillion over the next 20 years. About 25% of this amount would simply replace aging aircraft. In the immediate future, Boeing estimates necessary purchase costs to be at least $50 billion per year.[29]

The question of how these funds will be raised necessarily arises. Given the pervasive volatility of the industry, will such massive sums be available at all, especially to those carriers most in need? Historically, the airlines have relied on significant amounts of cash flow to provide funds for asset acquisition. Immediately after deregulation, for example, the industry financing was estimated to be about 60% of its capital spending from internal sources.[30] However, cash flow may only cover about 37% of capital spending through the current decade.[31] How will the deficit be made up? Given the leverage positions of most carriers, there are few easy answers.

The industry's record of low rates of return presents an additional problem. Faced with the difficulties associated with unfavorable leverage positions and the inherently high-risk nature of the business, rational investors should be expected to require commensurate compensation. During the years of this study, however, compensation has been meager. Exhibits VI and VII support this contention. (Note: Before a discussion of implications, some terms need to be defined. Return on assets (ROA) is computed by dividing operating profits (EBIT) by total assets. ROA measures the returns associated with operating leverage in particular, and business risk in general. Return on equity (ROE) is derived by dividing

27. Aircraft fleet age has had a direct correlation with the amount of productivity attributable to fuel consumption, maintenance costs per block hour, the hours of aircraft utilization, and higher real costs of ownership. ESG Aviation Services, The Airline Monitor 7, 17 (Feb. 1996).

28. Julius Maldutis, Address at the 7th AIATA High-Level Aviation Symposium.

29. Jeff Cole, *Boeing Raises Its Projections of Jet Demand*, WALL ST. J., Mar. 7, 1996 at A4.

30. NAWAL K. TANEJA, AIRLINE PLANNING: CORPORATE, FINANCIAL, AND MARKETING 34 (1982).

31. Edmund Greenslet, Address at the Chicago Convention 50th Anniversary Conference (Oct. 31, 1994).

EXHIBIT VI: YEARLY ROA AND ROE VALUES FOR THE YEARS 1979-1995

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
American																	
ROA	0%	3%	1%	0%	5%	8%	0%	2%	6%	9%	7%	1%	0%	0%	3%	5%	5%
ROE	–8%	3%	–11%	–18%	8%	17%	0%	4%	13%	23%	17%	–6%	–8%	–15%	5%	14%	11%
Continental																	
ROA	–3%	–8%	–7%	–6%	–13%	9%	12%	10%	1%	2%	4%	–8%	–8%	–6%	–1%	–2%	6%
ROE	–23%	–54%	–93%	–238%	–222%	–70%	362%	192%	–51%	–197%	–105%	–27%	–19%	–15%	–28%	–270%	20%
Delta																	
ROA	7%	8%	4%	–3%	–2%	9%	7%	5%	8%	9%	10%	–3%	–3%	–8%	–2%	–2%	9%
ROE	12%	14%	5%	–17%	–18%	15%	13%	8%	17%	19%	21%	–15%	–19%	–37%	–28%	–29%	37%
Northwest																	
ROA	5%	–2%	0%	–1%	4%	5%	3%	3%	5%	4%	5%	–2%	–1%	–4%	4%	9%	9%
ROE	6%	–5%	–1%	–2%	7%	10%	7%	5%	6%	6%	10%	–10%	–11%	–24%	6%	25%	19%
Southwest																	
ROA	9%	22%	17%	9%	12%	11%	8%	8%	N/A	7%	7%	6%	3%	8%	12%	10%	9%
ROE	18%	37%	22%	13%	39%	36%	11%	11%	N/A	10%	11%	8%	3%	14%	22%	19%	18%
TWA																	
ROA	–2%	–1%	0%	–4%	–2%	3%	–2%	–2%	6%	6%	1%	–5%	–13%	–17%	–9%	–9%	1%
ROE	–23%	–23%	–20%	–37%	–25%	–6%	–38%	–70%	0%	–231%	–106%	–72%	–83%	–42%	–2024%	–100%	–37%
United																	
ROA	–7%	–2%	–5%	–2%	4%	13%	–1%	0%	3%	10%	6%	–1%	–5%	–4%	2%	4%	7%
ROE	–33%	–19%	–32%	–34%	–2%	29%	–36%	–14%	3%	34%	18%	–11%	–41%	–106%	–4%	–316%	355%
USAir																	
ROA	10%	13%	7%	7%	11%	14%	10%	9%	15%	5%	–4%	–8%	–3%	–6%	–2%	–8%	3%
ROE	17%	26%	10%	11%	18%	25%	17%	14%	31%	8%	–11%	–29%	–18%	–66%	–85%	–285%	–19%

* Source: Values computed from data in *Air Carrier Financial Statistics*

EXHIBIT VII: RATES OF RETURN SUMMARY 1979-1995

ROA

	Mean	Std Dev	Coeff of Var	Range	
American	3.20%	2.98%	0.93	-0.47%	8.65%
Continental	-1.11%	7.00%	-6.34	-12.86%	11.83%
Delta	2.99%	5.61%	1.88	-8.07%	10.16%
Northwest	2.82%	3.60%	1.28	-3.79%	9.32%
Southwest	9.81%	4.23%	0.43	3.37%	21.76%
TWA	-2.92%	6.01%	-2.06	-17.45%	6.25%
United	1.36%	5.38%	3.96	-7.21%	13.10%
USAir	4.27%	7.53%	1.77	-8.39%	14.69%

ROE

	Mean	Std Dev	Coeff of Var	Range	
American	2.80%	11.89%	4.24	-17.81%	23.11%
Continental	-49.31%	148.99%	-3.02	-270.28%	361.68%
Delta	-0.15%	21.01%	-141.43	-37.02%	36.95%
Northwest	3.11%	11.22%	3.61	-24.48%	25.00%
Southwest	18.22%	10.40%	0.57	2.87%	38.84%
TWA	-172.79%	465.86%	-2.70	-2024.16%	0.09%
United	-12.41%	119.73%	-9.65	-316.15%	354.71%
USAir	-19.78%	73.36%	-3.71	-284.88%	31.43%

net profits by equity — the contribution to the asset base made by common stockholders. ROE measures the return associated with financial leverage. ROA will be volatile (i.e., highly variable) primarily because of business risk (i.e., operating leverage). ROE will be volatile because of both operating and financial leverage. In both cases, tracking the variation in average return rates can assess volatility. Here, standard deviations for ROA and ROE have been calculated to measure variation over the seventeen years of the study.[32] To control for disparities in the average size of carrier returns, a coefficient of variation (CV) for each carrier

32. The ROE calculations in the exhibit are pre-tax and *before* extraordinary items. In many cases, the carriers were losing money and hence paid no taxes. In any case, given constant tax rates, net profits before and after taxes would vary to the same degree. Because this study seeks to consider the effects of leverage on operations, extraordinary items (in most cases the results of sales of aircraft and/or routes or gate slots) were excluded on the grounds that they should not be part of management's decision making strategies since they are non-recurring items. For these reasons, the calculated ROEs will not necessarily agree with those returns published in carrier reports. In addition, this paper examines only carrier revenues and profits.

has been computed by dividing the standard deviation of its returns by its average return over the period of the study.[33]

Exhibit VII reveals two conditions which should cause serious concern:

(1) Low carrier mean ROAs with high standard deviations around these means, resulting in high CVs and wide ranges in ROAs over time.
(2) Low mean ROEs and/or large negative spreads between carrier ROAs and ROEs over time, high CVs and/or large negative spreads in the CVs, and large ranges in the ROEs over time.

Notably, average ROAs (with one exception) range from modest to poor. Most of the carriers had low nominal returns, but CAL and TWA showed average returns which were actually negative (-1.1% and -2.9%, respectively) over the seventeen-year time period. In addition, in all but two cases (AAL and SWA), standard deviations exceeded average returns, pointing again to the inherent volatility of operating profits already suggested by the DOL measures in Exhibit II. High Coefficients of Variation (CVs) and extreme ranges further reflect this pervasive volatility. SWA serves as an exception. SWA not only showed the highest average ROA (9.8%) and the narrowest range of returns (ROAs between 3.4% and 21.8%), but it also had a standard deviation (4.2%) less than half its mean return. Such indicators suggest SWA's unique operating strategies.

The prevalence of cases in which ROEs are lower than ROAs create even more concern than the generally poor ROA figures. As shown in Exhibit VI, ROEs were lower than ROAs for six of the eight carriers in the study (NWA's average ROA just barely exceeded its average ROE). Five carriers had negative ROE means.[34] Such conditions indicate the harmful effects of unfavorable financial leverage as measured by the DFL values computed in Section IV. Also disturbing here are the wider ranges and larger CVs (relative to ROA statistics shown in Exhibit VII).

To add to the negative picture, the small average ROEs shown here, especially in the cases of TWA (-2024%), UAL (-316%), and USAIR (-285%), underscore the severity of the industry's problems. (The large negative figures for TWA, UAL and USAIR result from small equity ba-

Thus, AAL's results cannot be compared to those of AMR Corp., the parent company of that airline.

33. An example may be instructive. Suppose Carrier A has a mean return of 20%, with a standard deviation of 10%. Carrier B has a mean return of 1% with the same standard deviation of 10%. One might be led to conclude that, since the standard deviations are equal, both carriers show the same degree of variation (risk). The CV helps to show more clearly the comparative risks. Carrier A's CV is 0.5 (.10/.20), while B's is 10.0 (.10/.01). Thus, carrier B's returns can be correctly judged the more risky .

34. This results from the strong years NWA experienced in the early and mid-1980s, when its debt burden was quite low.

ses as much as they result from large dollar losses).[35] SWA's performance once again stands as the exception. SWA's mean ROE of 18.2%, together with its relatively low risk measures, run counter to industry norms, tending to reflect the effectiveness of its conservative financial policies over time.

Thus, Southwest Airlines notwithstanding, industry returns for the years of the study were dismal.

V. Conclusion

This paper has defined several useful measures of airline industry risk by utilizing elasticities borrowed from microeconomic theory. Values for these measures have been presented for the eight major U.S. air carriers over the period 1979 through 1995. Degrees of operating, financial, and combined leverage were linked to carrier rates of return (on assets and on equity) during this seventeen-year span encompassing nearly the entire deregulatory history of the industry.

The findings of the study are revealing, although not wholly unexpected. The airline industry has long been recognized as an industry high in business risk, exhibiting a significant degree of variability in operating profits over extended periods of time. The results of the analysis reported here confirm this observation. The study does reveal suprisingly high degrees of financial leverage. Airlines facing high business risk should, arguably, moderate their exposure to financial risk by employing relatively low levels of financial leverage. Nevertheless, the majority of carriers in the study appear to have ignored this basic axiom. The penalty for such behavior was reflected in the pervasive volatility and low levels of profitability on carrier assets and equity during the period of the study. The approach of SWA, however, stands in sharp contrast and should provide an important lesson for future financial decision making in this industry.

Given the data presented, it seems clear that the long-term operating and financial performance of the airline industry has faltered. Historically high risk levels, as measured by DOL, DFL and DCL indicators, and chronically low rates of return, bode ill for an industry that has experienced more than its share of obstacles to overcome during the past two decades. As the airlines approach the Twenty-first century, the industry appears ill-prepared to generate the vast sums it will need to sustain itself.[36] Largely closed off to debt financing because of already-

35. UAL's financial situation is not quite as bad as indicated by the leverage analysis. UAL is committed to issuing 12.1 million shares of common stock each year through 1999. This results from the employees' buyout in 1994. *See* Value Line Investment Survey, *supra* note 1, at 263.

36. Homi P.R. Mullan, *Financing the Future*, *in* Int'l Air Transport Ass'n, A Vision

worrisome leverage positions and offering little in the way of reward to potential investors, some of the major carriers may have to sell assets, trade labor concessions for equity, locate new partners with whom to share the risk, or even merge with one another if they are to survive the next twenty years.[37]

The results of this study also suggest a re-examination of public policy as it relates to the air carriers. While some maintain that deregulation has had some beneficial effects, such as lower air fares in some highly competitive markets, it can be argued that deregulation has done so at the cost of sharply higher risks to many carriers. Two facts are particularly disturbing: (1) The bankruptcy, or near insolvency, of six major airlines since 1982, and (2) the stronger members of this industry are exposed to very high levels of total risk. The public policy implications arise in two important areas, safety and antitrust.

Regarding safety, lower profitability and higher financial risk provide incentives to cut back on resources allocated to safety, or to defer the purchase of modern, safe equipment. This is largely attributable to the continued diligence and efficacy of airline safety regulation and to the adoption of new technology retrofitted into existing aircraft or imbedded in new aircraft replacements. This paper has indicated that aircraft age has increased for six of the eight airlines in the study and that the replacement of the aging fleets will be the industry's greatest challenge. This suggests that (1) the public sector may have to expend additional resources to monitor safety records and procedures of airlines with older aircraft, or (2) more stringent standards should be established (e.g., more frequent inspections) in order to maintain safety in airline travel. The opportunity cost of not replacing aircraft with new, safer aircraft are the additional lives that may have be saved. If the government seeks to stay out of the economic regulation of the airline industry, it may want to consider alternative policies such as loan guarantees for the purchase of safer aircraft.

As industry concentration increases, an examination of antitrust policy becomes relevant. Research reveals an increasingly oligopolistic mar-

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OF THE FUTURE 69, 79 (1995). The Transportation Research Board has concluded: "The apparent financial condition of the major air carrier has been sufficiently weak to raise questions about the long-run health of the industry." The Board made specific mention of the carriers' excessive leverage and low rates of return on equity capital. TRANSPORTATION RESEARCH BOARD, WINDS OF CHANGE, DOMESTIC AIR TRANSPORT SINCE DEREGULATION 57 (1991). It also expressed concern over the airlines ability to ride out another recession and attract new capital for long-term investment to replace and expand their current fleets.

37. Some carriers have resorted to these alternatives in an effort to survive. Unfortunately, not all attempts have been successful. For a complete discussion of the different approaches, see DEMPSEY & GESELL, *supra* note 3; PAUL STEPHEN DEMPSEY & ANDREW GOETZ, AIRLINE DEREGULATION AND LAISSEZ FAIRE 129 (1992).

ket structure in the airline industry. Consequently, the debate now centers on whether this contributes to consumer welfare in the long run. In addition, many alliances currently being formed involve foreign carriers. This creates complicated foreign policy and trade questions which will have to be integrated with domestic objectives. The findings of this study suggest that the industry may become even more oligopolistic as major airlines use mergers and alliances to reduce business risk and improve asset utilization through the sharing or spreading of the financial risk of aircraft ownership.

Finally, the use of the leveraged buyout in an industry so vested with the public interest must be addressed. The case of NWA, noted above, shows the damage inflicted on a healthy carrier by the use of the LBO and the increased financial leverage which the debt created in the process has caused.[38]

38. *See* Jochner, *supra* note 22.