

**AIRLINE CAPITAL STRUCTURE: ONE PARAMETER IN THE  
SEARCH OF EFFICIENCY**

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# **AIRLINE CAPITAL STRUCTURE: ONE PARAMETER IN THE SEARCH OF EFFICIENCY**

## **ABSTRACT**

This article addresses performance, strategy and financial equilibrium in the worldwide civil aviation industry.

The sector's basic regulation and the need for large investment are characteristics of air transport, which make it capital intensive. These resources are financed by the company's own capital and that of third parties. Bearing in mind the sector's high level of indebtedness, we have sought to identify the relationship between these two sources of capital which gives the best financial performance over the long term. It is understood that both the operation and the stockholder must make a profit, a factor which is relevant to financial health. A healthy operation adds value for the customer and determines the business's lifespan. A stockholder with insufficient financial compensation is ready to transfer his capital to another investment. To avoid this transfer the company's global strategy has to be adapted to improving performance.

Some companies have been identified which have an ideal ratio of own capital to that of third parties. They are efficient companies which have adopted different financial strategies with consistently satisfactory financial performance with one peculiarity in common: the financial equilibrium, for the capital structure they have chosen.

## **I - INTRODUCTION**

The modern theory of capital structure has been constructed using Modigliani and Miller's assumptions. Many studies of an inconclusive nature have been made in an attempt to develop a theory which explains how companies choose their capital structure. Such a theory would point to

the best financial strategy to be followed and its implications. However, no capital structure can yet be categorically stated to be better than any other. With a view to helping clarify the existing problems this study proposes to add to the understanding of what is the best capital structure considering specifically the civil aviation industry.

Some research has been done on this theme though no work has been identified which follows the line of reasoning chosen in this study. Barral and Perraudin (1997) analyzed the efficiency implications of strategic debt services, showing that it can eliminate both direct bankruptcy and agency costs of debt. Rajan and Zingales (1995) investigate the determinants of capital structure choice by analyzing the financing decisions of public firms in the major industrialized countries. They found similarities between firms' leverage in the U. S. and in other countries. Leland (1994) examined corporate debt values and capital structure and he found that debt values and optimal leverage are explicitly linked to firm risk, taxes, bankruptcy costs, risk-free interest rates, payout rates, and bond covenants. He also elucidated the different behavior of junk bonds versus investment-grade bonds, and aspects of asset substitution, debt repurchase, and debt renegotiation. Mauer and Triantis (1994) analyzed the interaction between a firm's investment, operating, and financing decisions in a model with operating adjustment and recapitalization costs. They found that higher production flexibility enhances the firm's debt capacity, and that higher financial flexibility and production flexibility are, to some extent, substitutes. They also found that the impact of debt financing on the firm's investment and operating decisions is economically insignificant. Opler and Titman (1994) studied financial distress and corporate performance and found that highly leveraged firms lose substantial market share to their more conservatively financed competitors in industry downturns. Their other findings were that the indirect costs of financial distress are significant and positive, firms with specialized products are especially vulnerable to financial distress, highly leveraged firms that

engage in research and development suffer the most in economically distressed periods and that the adverse consequences of leverage are more pronounced in concentrated industries. Harris and Raviv (1991) reviewed papers about the theory of capital structure. They grouped them depending upon the model each one concerns: agency costs, asymmetric information, product/input market interactions, and corporate control considerations. In another survey Harris and Raviv (1990) analyzed capital structure and the informational role of debt. They postulated that managers are reluctant to relinquish control and unwilling to provide information that could result in such an outcome. Debt is a disciplining device because default allows creditors the option to force the firm into liquidation and generates information useful to investors.

Step by step, the different approaches chosen by authors have been exploring the subject but there are no specific studies of an individual industry. As a function of this analysis, we have looked for a global industry to study in order to find evidence which will assist in developing theories about capital structure.

The objective of this study is to research the level of indebtedness which provides the business with the best performance. Financial health is therefore considered to be one of the relevant factors. Basically, both the operation and the stockholder must receive a financial return. A healthy operation adds value for the customer and determines the lifetime of the business. The stockholder whose financial compensation is unsatisfactory is ready to invest elsewhere. In this event the company's global strategy suffers a change with a view to improving performance.

Another relevant factor is the industry in question. According to Porter (1986) *industry structure has a strong influence in determining competitive rules of the game as well as the strategies which are potentially available to the company*. In this sense financial strategy can be understood as the determining factor in companies' performance and as an important element for sustaining the business in the competitive environment in which it operates. It is necessary,

therefore, at the start, to review the way in which competition in civil aviation is structured, its rules and other characteristics.

## **II – CHARACTERISTICS OF THE AIR TRANSPORT INDUSTRY**

Competition between companies which operate globally has distinctive characteristics. Civil aviation's peculiarity is to compete in different ways in different markets. For international passenger and freight transport there are a basic regulations but each domestic market has its own specific characteristics.

The air transport industry is regulated all over the world. This implies a geopolitical division of markets. Companies only obtain a license for operating beyond their national frontiers by means of a reciprocal agreement. One company may transport passengers from its own country to another if, and only if, a company from the other country may transport passengers to its own. Competition is not free and markets are protected. These decisions were codified in the Chicago Convention (basic regulation of world civil aviation) in 1944.

In domestic markets only domestic companies operate. A large proportion of these markets is also regulated though in some countries at different times there has been deregulation with consequent freedom of competition. In other countries the market remains closed and new entrepreneurs are not free to enter the business on their own free initiative. Formal authorization from the industry's regulating bodies is one requirement. In addition there are, for example, regulations as to price (tariff) and destination to be served (definition of routes). These limitations represent entry barriers for competition in the air transport business.

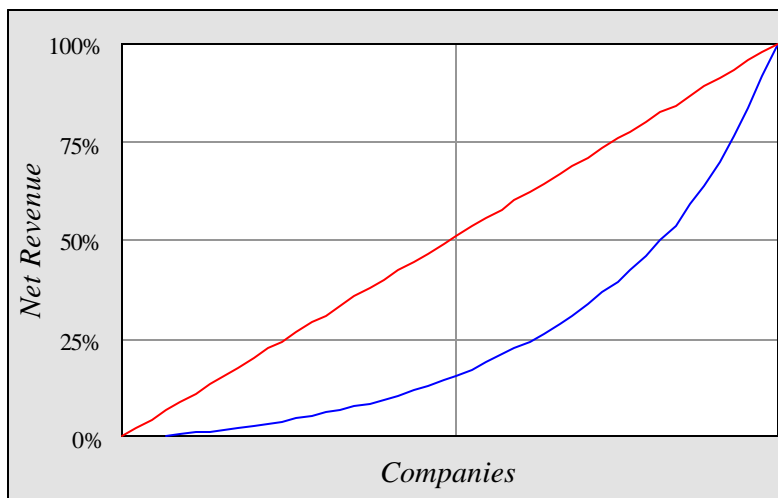
Besides the industry's regulation, another relevant entry barrier for competition is the need for capital. Passenger and freight transport by air requires fixed assets representing a high proportion of total investment. The fixed capital needed to set up and maintain the company's

operations is large. However, this fixed investment in the shape of aircraft and spares can be used by other companies. In the event of financial difficulties the company has the alternative of using these tangible assets as security for finance or even of selling them.

Leasing is an alternative to investing in aircraft. In an operational leasing contract the company bears the leasing cost without tying up its capital. Contracting a fixed cost of this kind, however, leaves the company vulnerable if revenue falls. In this way, companies have two ways of getting the aircraft they need for their business: purchase or operational leasing.

Very largely because of the need for high investments or fixed costs, aviation companies pay special attention to economies of scale. The bigger the company the lower its unit fixed costs tend to be. Bargaining power vis-à-vis possible suppliers becomes greater and discourages new entrants. In principle, size represents a relevant variable in the business. This may be considered one reason for the industry's concentration as shown in Figure 1.

Figure 1 – Lorentz Curve for Aviation Companies, 1996



The Lorentz Curve for aviation companies shows approximately 15% of total net revenue for 1996 was shared by 50% of the companies selected. The remaining 85% of net revenue was shared by the other 50% of the companies. The total of 43 companies revenues are shared equally between one group of 35 companies and another group of 8 companies.

In domestic markets of the majority of countries there are few companies in the business as a result of internal regulation and entry barriers. However, there are domestic markets where competition is free. As an example, we can point to the United States which deregulated the domestic market in 1978 with the aim of creating an environment for lower fares<sup>1</sup>. Following this example in 1997 the countries of the European Union (plus Norway and Iceland) decided to liberate their domestic markets for foreign companies belonging to the bloc.

In this industry a small number of companies operate international routes. Laws relating to this market prohibit mergers, in general. As a solution, companies tend to form alliances whose advantages include: operating in a closed market, achieving economies of scale, sharing research and development, marketing and distribution costs, acquiring technology and reducing financial risk. On the other hand, they are difficult to manage. Two thirds of the alliances existing in 1991 had failed by 1996. Table 1 shows the companies making up each alliance.

Table 1 – Airline Alliances, 1995.

<i>Partners (Revenue-passanger Km)</i>	<i>Total RPKs</i>
American(165), Canadian(24), JAL(70), British Airways(94), Qantas(52)	404
United(180), Lufthansa(62), Thai(27), SAS(19), Air Canada(26), Varig(21), SAA(13)	347
Delta(137), Singapore(48), Swissair(20), Sabena(9), Air France(50)	263

<sup>1</sup> The domestic market was transformed as a result. Tariffs fell rapidly to one third of their former level and traffic more than doubled. Some companies disappeared, such as the famous PanAm. Other companies appeared. In 1997 American tariffs were, on average, about half European tariffs.

Northwest(101), KLM(45)	145
Continental(57), Alitalia(32)	89

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Source: Paribas, in The Economist april 5<sup>th</sup> 1997

These partnerships are being modified. Around the beginning of 1998 there was a group led by American Airlines of which TAM was a part and another, called Star Alliance, including Varig, United Airlines, Thai Airways International, Air Canada, SAS and Lufthansa and another bringing together Delta Airlines, Swissair, Austrian Airlines, Sabena, Korean Air and Aero Mexico in which Transbrasil was negotiating participation. These agreements included operating and/or marketing partnerships.

In the United States Northwest and Continental Airlines set up a wide ranging alliance, virtually a merger. American Airlines and US Airways were linked by mileage programs and there was an alliance between United Airlines and Delta Airlines. These agreements have been analyzed by the U.S. Justice Department with a view to preventing the formation of cartels.

Current Brazilian legislation allows foreign ownership of up to 20% of Brazilian aviation companies but the agreements which have been struck between Brazilian and foreign companies do not appear to involve one company acquiring a stake in the other.

Keeping in mind the competitive nature of the world aviation industry, this study proceeds to present the conceptual base.

### **III –CONCEPTUAL BASE**

Analysis of organizations' performance has been a keynote of the world globalization process. It is impossible to compete in this scenario without a continual quest for returns which are above average or even unequalled. This kind of higher performance can be attained by following paths which are quite different. The paths traced by those who have studied the subject

are strongly influenced by each one's background. That is to say, economists, managers, engineers etc seek to formulate a worldview based on their own particular outlook, arriving at only a partial view of the subject. One example of a partial view of the question of the organizations' productivity is the never-ending struggle over measuring the amounts of organizations' productivity to be attributed to capital and to labor.

In 1950 the Organization for European Economic Cooperation (OEEC) developed the following definition of productivity: "Productivity is the quotient obtained by dividing production by one of the factors of production". In this way it is possible to talk of capital, investment or raw material productivity in relation to capital, investments and raw material quantities.

Basically, therefore, when a certain number of inputs produces greater quantities of outputs, it means there has been an increase in productivity. If we are dealing with a single variable of both output and input, this calculation is simple, but usually we are faced with different types of input which are aggregated to produce other outputs, as noted by Lovell (1993). In this way, in order to calculate productivity we have to know and measure the different variables which make up both the inputs and the outputs. To find them is, in practice, a very complex task since the proportions of the outputs may change with time or vary from one company to another, making it difficult to define total output. This is because it would be difficult for an industry to have only a single output. Sometimes, depending on the productive process, it is possible to vary, within certain limits, the quantities and types of products obtained. To aggregate these outputs in a single value one has to use some form of weighting in accordance with each output's relative importance. As to inputs, adequate measurement is as difficult as it is with outputs because different inputs such as equipment, energy, raw materials, labor etc. have to be aggregated in order to produce the outputs.

There are two ways of measuring both outputs and inputs: physically, i.e. quantities of different types of product manufactured, total number of employees, number of passengers carried etc. and financially, corresponding to total production revenue, cost of labor, capital performance, etc.

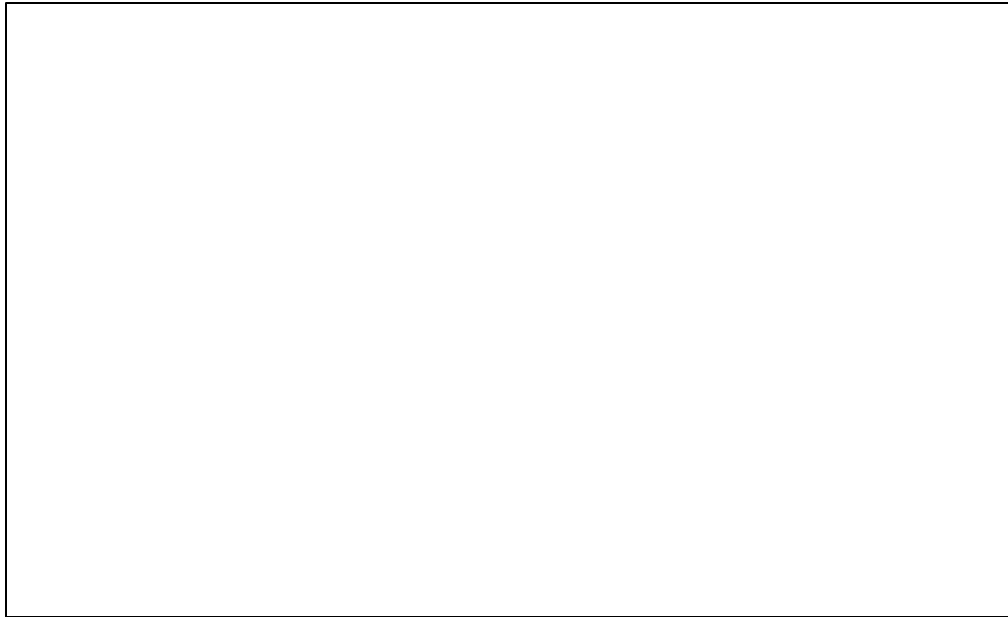
Looking at the relationship between outputs and inputs, we see that there are two basic types of productivity: total and partial. Total productivity measures the relationship between all inputs and all outputs, consequently reflecting the combined impact of all the inputs used to manufacture the products.

As it is so difficult to calculate global indices of productivity, measurements of partial productivity have come to be developed. These partial indices measure one or more outputs against one or more inputs, giving a partial instead of a total index. These partial measures of productivity have the great disadvantage of not supplying a complete picture, without doubt a serious limitation. For example, a company might at a particular stage of a production process use more labor than another firm which has the same process automated. In calculating the partial labor productivity we are making a localized analysis forgetting the big picture. In other words, one company is more productive than another in relation to one input, in this case electric power. It should not be forgotten that we are referring to only a single production process. This does not necessarily mean that one company is more productive than the other as relevant aspects of the total process have not been taken into consideration.

The tool called Data Envelopment Analysis (DEA) is a non-parametric method used for measuring the performance of a firm, organization or program. i.e. whatever is produced by Decision-Making Units (DMU). This procedure is a mathematical technique based on linear programming which does not need the functional form relating inputs to outputs to be specified. DEA optimizes each observation with a view to constructing an efficiency frontier (Figure 2). This

consists of a discrete curve made up only of efficient DMU's. Obviously, we are dealing with relative efficiency as we are using samples. After determining the frontier we move on to the sample's benchmark for efficiency.

Figure 2 – Data Envelopment Analysis



Charnes et al. (1994) posited that DEA involves an alternative principle for extracting information about a group of observations. In contrast to the parametric approaches whose objective is to optimize a regression plan by data analysis, DEA optimizes every observation in order to calculate a frontier determined by Pareto-efficient DMU's. In this way DEA makes possible an efficiency analysis of each DMU and of possible ways of developing in the direction of the efficiency frontier (Figure 3). Taking as an example  $DMU_i$  in Figure 3 it can be seen that an inefficient DMU can follow different development routes exemplified as  $r_1$  to  $r_6$ . DEA mathematical models work, basically, with alternatives  $r_1$ ,  $r_2$  and  $r_3$  which relate respectively to

approaches oriented towards input, the shortest route to the frontier and output.  $R_1$  and  $r_3$  delimit Quadrant I (QI) where the organizations generally seek alternatives for positioning themselves in search of the efficiency frontier. However, organizations more disposed to take risks can choose  $r_4$  in QII, a route which seeks the efficiency frontier over a greater distance and for this reason incurs greater risks. QIII, where  $r_5$  is positioned, is a quadrant which indicates a route denoting deteriorating performance and loss of competitiveness. An organization which is heading down this path will have great difficulty in surviving. Quadrant IV, where  $r_6$  is positioned, indicates a recessive scenario for the organization which needs to scale down its production and seek the frontier at a point on a lower scale.

An important point in the formulation of the DEA is the level of inefficiency of each variable analyzed, both inputs and outputs. For example, in the case shown in Figure 3 if the  $DMU_i$  decided to adopt the output oriented approach, i.e. route  $r_5$ , we would have output inefficiency  $O$  equal to the distance from the DMU to the frontier by route  $r_3$ . To facilitate graphic representation, the case shown in Figure 3 presents only one input and one output but the conclusions in this case would be valid for several different inputs and outputs.

Figure 3 – Routes to Improving Performance



Charnes et al. (1994) developed several formulations as an approach to DEA. In the research carried out for this study the main question is with respect to the minimization of inputs that organizations are capable of. In this way an approach has been chosen which is input oriented in a model with a variable revenue scale (VRS) as the article deals with organizations of different sizes. The convex shape of the efficiency frontier can be seen in the case we are analyzing. DMU's above the efficiency frontier with lower scale at the meeting of straight line TG with this frontier present returns growing in scale while those above represent returns diminishing in scale, as Banker et al explain (1984). The proposed model involves the following problem of linear programming:

Input-Oriented BCC Primal

$(BCC_p-I)$

$$\begin{aligned}
\min \quad & z_0 = \mathbf{q} - \mathbf{e} \cdot \mathbf{1} s^+ - \mathbf{e} \cdot \mathbf{1} s^- \\
\mathbf{q}, \mathbf{l}, s^+, s^- \quad & \\
s.t. \quad & \mathbf{Y}\mathbf{l} - s^+ = Y_0 \\
& \mathbf{q}\mathbf{X}_0 - \mathbf{X}\mathbf{l} - s^- = 0 \\
& \mathbf{1}\mathbf{l} \geq 1 \\
& \mathbf{l}, s^+, s^- \geq 0
\end{aligned}$$

Input-Oriented BCC Dual

(BCC<sub>D-I</sub>)

$$\begin{aligned}
\max \quad & w_0 = \mathbf{m}^T Y_0 + u_0 \\
\mathbf{m}, \mathbf{n} \quad & \\
s.t. \quad & v^T X_0 = 1 \\
& \mathbf{m}^T Y - \mathbf{n}^T X + u_0 \mathbf{1} \leq 0 \\
\cdot \quad & -\mathbf{m}^T \leq -\mathbf{e} \cdot \mathbf{1} \\
\cdot \quad & -v^T \leq -\mathbf{e} \cdot \mathbf{1} \\
& u_0 \text{ free}
\end{aligned}$$

Where  $\mathbf{X}$  is the input vector used in the DMUs,  $\mathbf{Y}$  is the output vector produced by the DMUs,  $\mathbf{e}$  is a constant non-Archimedean (infinitesimal of the order  $10^6$ ) that ensures no input or output is given a zero weight,  $s^+$  and  $s^-$  are the slack vectors for the outputs and inputs, respectively.  $\mathbf{q}$  represents the proportional reduction of the input in relation to the amount of the projected input. The optimal value of  $\mathbf{l}$  forms a composite unit outperforming the DMU under analysis and providing targets for this DMU to identify sources of its inefficiency.

This model is known as input-oriented BCC, the initials being in recognition of its formulators Banker et al. (1984).

#### IV – EFFICIENCY OF THE SELECTED AIRLINE COMPANIES

In order to measure productivity and efficiency with as clean a data set as possible, we use the data of corporate financial statements compiled by Getting Results Airline Financial Profiles

(1997). This data set enables comparison between firms because it's adjusted to the IATA's rules. A sample of 94 observations has been taken comprising 35 companies operating in the world market from 1993 to 1996. As it intended to compare companies of different origins the sample includes companies from 22 countries. Financial leverage (FL) was treated as an input and net margin (NM), total assets turnover (TA), return on equity (ROE), operating margin<sup>2</sup> (OM), net assets turnover (NAT) and return on net assets (RONA) were treated as outputs. In the model adopted variable economies of scale are assumed so that doubling input results in outputs less than doubling. It is noted that the increase in financial leverage (third party funds entering the business) is not followed by proportional increases in the different outputs. Revenue decreases to the extent that the proportion of third party capital to stockholders' capital increases in the business. An immoderate increase in third party capital does not pay.

The results obtained for the sample of selected airline companies are shown in appendix 1. Appendix 2 shows the initials, name and country of origin of the airline companies selected.

Looking at this group of companies one can state that Singapore 93, Britannia 93, TAM 93, Singapore 94, Britannia 94, TAM 94, Air 2000 94, Singapore 95, TAM 95, Continental 95, TAM 96 and Air 2000 96 are efficient in relation to the financial leverage they use for obtaining reported financial results. Their level of third party capital is the lowest possible in the context of the group of companies in question. These companies comprise the efficient frontier. But they demonstrate different financial strategy. What is relevant is the equilibrium between third party capital and the different performance indicators which have been noted.

The other companies in the sample are considered inefficient in differing degrees. A path to improvement is indicated in each case. These indications are based on the performance

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<sup>2</sup> Operating margin is before tax on profits. It was impossible to identify the effective tax of each company.

observed in efficient companies. Appendix 1 indicates for each company the path to be followed and the specific change need in each variable.

In appendix 1,  $\theta$  (theta) represents proportional reduction in input in relation to the amount of input projected. Its values are shown increased from base 1. To calculate the percentage, deduct one and multiply by a hundred.

The  $I(s)$  represent inefficiencies observed in each variable. The values which will take the company to the efficiency frontier are shown. As for outputs, when this value is zero, no change is required. As to input, the reduction indicated for financial leverage is considerable.

$\lambda$  (lambda) indicates one or more DMU's which are efficient in comparison with the DMU analyzed individually. Besides this indication, the best route for arriving at the efficiency frontier is also given. The nearer the unit is to its value the easier it will be to get close to the frontier. The closer the value is to zero, the more complex will be the path to reaching the frontier. It is worth remembering that the company's efficiency is obtained by taking account of all its variables.

Analysing the DMU's at the frontier which point the way for inefficient companies, the percentages shown in table 2 have been calculated for each company.

Table 2 – Efficient frontier, years of 1993, 1994, 1995 and 1996.

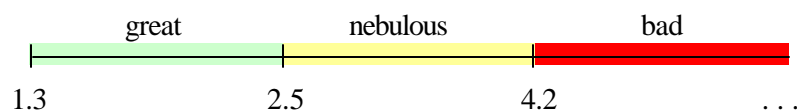
Efficient companies	DMU's percentage of recommendation	FL	TA	NM	ROE	OM	NAT	RONA
SIN93	23.5%	1.3	0.57	0.13	0.10	0.12	0.85	0.10
BRN94	18.0	1.9	2.16	0.04	0.15	0.03	3.09	0.09

TAM96	15.5	2.5	1.80	0.11	0.52	0.16	2.88	0.46
BRN93	14.5	2.0	2.31	0.03	0.12	0.05	3.66	0.19
SIN94	9.5	1.3	0.54	0.14	0.10	0.13	0.80	0.10
SIN95	9.5	1.3	0.50	0.15	0.10	0.14	0.80	0.11
AI296	7.5	2.3	1.50	0.10	0.35	0.13	3.39	0.43
TAM95	1.0	3.5	1.80	0.11	0.69	0.20	2.70	0.54
TAM94	0.5	4.2	2.20	0.06	0.56	0.17	3.46	0.58
AI294	0.5	7.1	1.22	0.04	0.31	0.15	3.78	0.56

TAM 93 and Continental 95 are not recommended in any case. The companies which were cited in many cases are really at the frontier. The others were placed at the frontier by some variable different from the greater part of the sample. They should be viewed with caution as their value is limited as an example and for purposes of comparison.

Table 2 shows that the companies with a low rating of financial leverage, are the most quoted. Based on this observation the leverage intervals that contain efficient companies and non-efficient companies are identified. Figure 4 shows the leverage intervals.

Figure 4 – Financial leverage intervals.



The aviation companies with leverage rating between 1.3 and 2.5 are efficient. They have an excellent capital structure, to give support a superior financial performance, of all the companies shown. This means a participation os shareholder capital from 75% to 40% of the total financing. These companies show a financial balance. They keep their business with a low level of financial risk.

In the nebulous area companies are in spite of being in the efficiency frontier they show a high financial risk. This would not be the best capital structure. The parts that negotiate to companies realize the high financial risk and charge a prize for it. This real perception burdens the operation and creates a strategic instability for the company. Maybe, in a short term this capital structure would be justifiable for the project investment application, being followed by operational redeem.

TAM 94, TAM 95 and Air 2000 94 are found in the nebulous area. These companies have modified their capital relation, getting in 96, a good capital structure.

The financial leverage over 4.2 is indicated as bad. An excess of elevation of the financial risk provoke much instability, leaving the company vulnerable to the creditor's eyes, suppliers, customers and government. If the company can maintain enough return to attend the requirement of negociable parts, could maintain the operation working, nevertheless, the good management of the obligations turn down to be more critical. A small oscillation in income could lead the company to fail on the execution of contracts.

## **V - CONCLUSIONS**

This study has sought to analyze financial strategies followed by civil aviation companies. A number of companies have been identified which operate in the market with an ideal ratio of own capital to third parties'. They are efficient companies adopting different financial strategies, which maintain their financial performance, with the common peculiarity of achieving financial equilibrium with the capital structure they have chosen.

The civil aviation industry includes results like this because it has peculiar characteristics. One can point to (1) the division of the international market, (2) the intense reservation of

domestic markets in favor of domestic companies, (3) the formation of alliances seeking to overcome legal rigidities, (4) the need for large capital; and (5) operations in a global market.

In this way companies, besides being relatively protected strategically are capital intensive and have the world market as their business partner, a possible source of finance, a consumer market and a supplier.

Having analyzed some factors relevant for the airline industry one can conclude that much research is needed to clarify obscure points. For an industry with civil aviation's characteristics there are gaps in the study of capital structure. As avenues to be explored one could suggest a comparison of free domestic markets with regulated domestic markets lacking internal competition, companies' financial health in view of possible free world competition, the impact of leasing versus purchase of aircraft, possible advantages of economies of scale and the supposed advantage of contracting new debt when the business has a high proportion of tangible assets.

## **VI - BIBLIOGRAPHY**

Banker, R. D., Charnes, A., Cooper, W. W., 1994, "Some models for estimating technical and scale inefficiencies in data envelopment analysis." *Management Science*, 30(9): 1078-1092.

Barral, P. M., Perraudin, W., 1997, "Strategic Debt Service," *The Journal of Finance*, (June).

Berger, P. G., Ofek E., Yermack, D. L., 1997, "Managerial Entrenchment and Capital Structure Decisions," *The Journal of Finance* (September).

Charnes, A., Cooper, W. W., Lewin, A. Y., Seiford, L. M., 1994, "*Data Envelopment Analysis: Theory, Methodology and Applications.*" Kluwer Academic Publishers, Boston.

- Cornett, M. M., Travlos, N. G., 1989, "Information Effects Associated with Debt-for-Equity and Equity-for-Debt Exchange Offers," *The Journal of Finance* (June).
- Doganis, R.; Alamdari, F.; Lobbenberg, A. , 1995", "Efficiency of the World's Major Airlines," Cranfield University.
- Froot, K. A., Scharfstein, D. S., Stein, J. C., 1994, "A Framework of Risk Management," *Harvard Business Review* (November-December).
- Getting Results Airline Financial Profiles, 1997, Quadrant House, Sutton. United Kingdom..
- Gritta, R. D., 1979, "The effect of financial leverage on air carrier earnings: a break even analysis," *Financial Management Association* (Summer) 53-60.
- Harris, M., Raviv, A., 1990, "Capital Structure and the Informational Role of Debt," *The Journal of Finance* (June).
- \_\_\_\_\_, 1991, "The Theory of Capital Structure," *The Journal of Finance* (March).
- Lambrix, R. J., Singhvi, S.S., 1981, "How to set volume-sensitive ROI targets," *Harvard Business Review* (March-April).
- Leland, H. E., 1994, "Corporate Debt Value, Bond Covenants, and Optimal Capital Structure," *The Journal of Finance* (September).
- Lovell, C. A. K., 1993, "Production frontiers and productive efficiency", in Fried, H. O., Lovell, C. A. K., Schmidt, S. S. (eds), "*The measurement of productive efficiency.*" Oxford University Press, New York.
- Mauer, D. C., Triantis, A. J., 1994, "Interactions of Corporate Financing and Investment Decisions: A Dynamic Framework," *The Journal of Finance* (September).
- Opler, T. C., Titman, S., 1994, "Financial Distress and Corporate Performance," *The Journal of Finance* (July).
- Porter, M. E., 1986, "Estratégia Competitiva". Editora Campus Ltda.

- \_\_\_\_\_, 1996, "What's in Strategy?," *Harvard Business Review* (November-December).
- Rajan, R. G., Zingales, L., 1995, "What Do We Know about Capital Structure? Some Evidence from International Data," *The Journal of Finance* (December).
- Roach, S. S., 1996, "The Hollow Ring of the Productivity Revival," *Harvard Business Review* (November-December).
- Sweeney, R. J., Warga A. D., Winters D., 1997, "The Market Value of Debt, Market Versus Book Value of Debt, and Returns to Assets," *Financial Management*, vol 26, n° 1 (Spring) 5-21.
- The Economist, 1996, "A Survey of Corporate Risk Management - Too hot to handle?," (February 10<sup>th</sup>).
- \_\_\_\_\_, 1997, "Freedom in the air." (April 5<sup>th</sup>).
- Tufano, P., 1996, "How Financial Engineering Can Advance Corporate Strategy," *Harvard Business Review* (January-February).
- Tully, S., 1993, "The Real Key to Creating Wealth," *Fortune* (September 20).
- Wruck, K. H., 1994, "Financial policy, internal control, and performance Sealed Air Corporation's leveraged special dividend," *Journal of Financial Economics*, (36) 157-192.

Appendix 1 – Selected Air Transport Companies - DEA VRS Model Input Oriented – 1993, 1994, 1995 e 1996.

DMU	Inefficiencies								I
	q	I <sub>FL</sub> <sup>-</sup>	I <sub>TA</sub> <sup>+</sup>	I <sub>NM</sub> <sup>+</sup>	I <sub>ROE</sub> <sup>+</sup>	I <sub>OM</sub> <sup>+</sup>	I <sub>NAT</sub> <sup>+</sup>	I <sub>RONA</sub> <sup>+</sup>	
AI293	0.466	-2.51	0.14	0.05	0.00	0.05	0.00	0.14	TAM96=0.24;SIN93=0.16;AI296=0.60
AII93	0.333	-2.60	0.05	0.11	0.02	0.09	0.17	0.08	SIN93=1.00
AIZ93	0.576	-1.06	0.00	0.06	0.00	0.03	0.21	0.03	TAM96=0.04;SIN94=0.80;BRN94=0.16
AIB93	0.630	-1.06	0.00	0.04	0.02	0.01	0.23	0.00	BRN93=0.14;SIN93=0.30;BRN94=0.56
AMT93	0.480	-2.03	0.26	0.04	0.08	0.05	0.00	0.14	BRN93=0.81;SIN93=0.19
BRN93	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	BRN93=1.00
CAT93	0.470	-1.64	0.16	0.05	0.00	0.03	0.37	0.08	TAM96=0.13;SIN95=0.87
CHI93	0.491	-1.38	0.00	0.07	0.00	0.04	0.14	0.05	SIN94=0.98;TAM96=0.01;BRN=0.01
EMI93	0.301	-3.22	0.00	0.09	0.00	0.04	0.10	0.05	TAM96=0.05;SIN94=0.92;BRN94=0.03
FIN93	0.307	-3.19	0.00	0.09	0.01	0.07	0.14	0.06	SIN93=0.81;BRN94=0.19
KLM93	0.289	-3.20	0.00	0.13	0.07	0.08	0.03	0.06	SIN94=0.40;SIN93=0.60
KOR93	0.136	-8.30	0.00	0.12	0.07	0.00	0.08	0.01	SIN93=0.99;BRN94=0.01
LOT93	0.473	-1.63	0.18	0.10	0.09	0.06	0.00	0.06	SIN93=0.76;BRN93=0.24
MAL93	0.361	-2.30	0.18	0.15	0.10	0.10	0.37	0.09	SIN93=1.00
MAR93	0.441	-1.68	0.07	0.07	0.00	0.04	0.20	0.05	TAM96=0.02;SIN95=0.98
MON93	0.383	-3.02	0.22	0.05	0.00	0.03	0.00	0.06	SIN93=0.22;AI296=0.28;BRN94=0.50
SIN93	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	SIN93=1.00
STH93	0.646	-0.85	0.00	0.06	0.00	0.00	0.11	0.00	TAM96=0.08;SIN95=0.74;AI296=0.08;BRN93=0.10
SWI93	0.431	-1.82	0.08	0.11	0.08	0.08	0.00	0.07	SIN93=0.89;BRN93=0.11
TAM93	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	TAM93=1.00
THA93	0.265	-3.60	0.00	0.12	0.05	0.05	0.15	0.05	SIN93=0.60;SIN95=0.40
AI294	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	AI294=1.00
AII94	0.351	-2.40	0.00	0.13	0.07	0.11	0.05	0.09	SIN93=0.40;SIN94=0.60
AIZ94	0.637	-0.87	0.00	0.05	0.00	0.02	0.18	0.03	TAM96=0.13;SIN94=0.74;BRN94=0.13
AIB94	0.637	-1.02	0.00	0.04	0.04	0.01	0.18	0.00	BRN93=0.19;SIN93=0.22;BRN94=0.59
AMT94	0.393	-2.85	0.25	0.04	0.06	0.05	0.00	0.13	BRN93=0.78;SIN93=0.22
BRN94	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	BRN94=1.00
CAT94	0.451	-1.76	0.13	0.06	0.00	0.02	0.29	0.06	TAM96=0.12;SIN95=0.88
CHI94	0.550	-1.08	0.00	0.12	0.08	0.09	0.14	0.08	BRN94=0.03;SIN93=0.97
EMI94	0.335	-2.72	0.00	0.09	0.00	0.04	0.03	0.03	SIN94=0.89;BRN94=0.10;TAM96=0.01

Appendix 1 – Selected Air Transport Companies - DEA VRS Model Input Oriented – 1993, 1994, 1995 e 1996 (continued)

DMU	Inefficiencies								I
	q	I <sub>FL</sub> <sup>-</sup>	I <sub>TA</sub> <sup>+</sup>	I <sub>NM</sub> <sup>+</sup>	I <sub>ROE</sub> <sup>+</sup>	I <sub>OM</sub> <sup>+</sup>	I <sub>NAT</sub> <sup>+</sup>	I <sub>RONA</sub> <sup>+</sup>	
FIN94	0.486	-1.59	0.00	0.07	0.00	0.04	0.13	0.04	TAM96=0.10;SIN94=0.76;BRN94=0.14
KLM94	0.315	-2.94	0.01	0.10	0.00	0.05	0.05	0.05	TAM96=0.05;SIN95=0.95
KOR94	0.165	-6.68	0.00	0.11	0.04	0.03	0.09	0.03	SIN93=0.97;BRN94=0.13
LOT94	0.456	-1.85	0.24	0.09	0.10	0.05	0.00	0.06	SIN93=0.64;BRN93=0.36
MAL94	0.361	-2.30	0.14	0.09	0.03	0.04	0.31	0.06	SIN93=1.00
MAR94	0.419	-1.80	0.06	0.10	0.03	0.04	0.19	0.05	SIN93=1.00
MON94	0.860	-0.60	0.36	0.01	0.03	0.05	0.00	0.18	AI294=0.33;BRN93=0.67
SIN94	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	SIN94=1.00
STH94	0.677	-0.74	0.00	0.06	0.00	0.00	0.18	0.00	SIN95=0.70;AI296=0.17;BRN93=0.13
SWI94	0.434	-1.81	0.10	0.11	0.09	0.09	0.00	0.09	BRN93=0.12;SIN93=0.88
TAM94	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	TAM94=1.00
THA94	0.266	-3.67	0.03	0.10	0.00	0.01	0.19	0.03	TAM96=0.03;SIN95=0.97
AEL95	0.243	-4.39	0.00	0.09	0.02	0.04	0.00	0.02	SIN93=0.82;BRN94=0.15;BRN93=0.03
AI295	0.763	-0.92	0.50	0.00	0.04	0.00	0.00	0.00	TAM94=0.16;TAM95=0.31;AI296=0.53
AIC95	0.216	-5.10	0.00	0.10	0.03	0.04	0.05	0.03	SIN93=0.83;BRN94=0.17
AI295	0.673	-0.78	0.00	0.04	0.00	0.02	0.19	0.05	TAM96=0.23;BRN94=0.06;SIN94=0.71
AIB95	0.593	-1.22	0.00	0.04	0.08	0.02	0.14	0.02	SIN93=0.20;BRN94=0.80
ALA95	0.249	-4.66	0.10	0.08	0.03	0.04	0.00	0.03	BRN93=0.35;SIN93=0.65
AMW95	0.629	-0.89	0.00	0.08	0.04	0.02	0.13	0.00	AI296=0.05;SIN95=0.72;BRN93=0.23
AMR95	0.282	-3.80	0.20	0.09	0.06	0.04	0.00	0.03	BRN93=0.28;SIN93=0.72
ANS95	0.104	-14.33	0.06	0.12	0.00	0.08	0.00	0.12	SIN93=0.25;SIN95=0.44;TAM96=0.31
BRA95	0.472	-1.64	0.00	0.07	0.00	0.02	0.03	0.02	TAM96=0.10;BRN94=0.08;SIN94=0.82
BRI95	0.386	-2.45	0.02	0.08	0.00	0.05	0.10	0.07	SIN95=0.80;TAM96=0.20
CAT95	0.486	-1.59	0.17	0.04	0.00	0.02	0.34	0.07	TAM96=0.17;SIN95=0.83
CHI95	0.582	-0.96	0.00	0.10	0.06	0.10	0.07	0.09	BRN94=0.06;SIN93=0.94
CON95	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	CON95=1.00
DEL95	0.301	-4.28	0.60	0.04	0.00	0.03	0.00	0.07	SIN93=0.21;AI296=0.36;BRN94=0.43
EMI95	0.356	-2.51	0.01	0.09	0.01	0.05	0.00	0.04	SIN93=0.87;BRN93=0.13
FED95	0.598	-1.17	0.11	0.04	0.00	0.02	0.00	0.00	BRN93=0.37;SIN93=0.38;AI296=0.65;BRN94=0.18
FIN95	0.569	-1.16	0.00	0.06	0.00	0.02	0.11	0.00	TAM96=0.07;BRN94=0.26;SIN94=0.67

Appendix 1 – Selected Air Transport Companies - DEA VRS Model Input Oriented – 1993, 1994, 1995 e 1996 (continued)

DMU	Inefficiencies								I
	q	I <sub>FL</sub> <sup>-</sup>	I <sub>TA</sub> <sup>+</sup>	I <sub>NM</sub> <sup>+</sup>	I <sub>ROE</sub> <sup>+</sup>	I <sub>NM</sub> <sup>+</sup>	I <sub>NAT</sub> <sup>+</sup>	I <sub>RONA</sub> <sup>+</sup>	
LUF95	0.574	-1.58	0.34	0.03	0.00	0.08	0.00	0.24	AI296=0.79;SIN93=0.16;BRN94=0.05
MAR95	0.371	-2.20	0.09	0.11	0.05	0.03	0.25	0.05	SIN93=1.00
QAN95	0.358	-2.50	0.01	0.09	0.02	0.04	0.00	0.03	SIN93=0.86;BRN93=0.14
SAS95	0.559	-1.37	0.00	0.05	0.00	0.05	0.15	0.09	TAM96=0.32;BRN94=0.08;SIN94=0.60
SIN95	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	SIN95=1.00
STH95	0.650	-0.81	0.00	0.06	0.00	0.02	0.08	0.00	AI295=0.09;SIN95=0.76;BRN93=0.15
TAM95	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	TAM95=1.00
THA95	0.281	-3.45	0.00	0.10	0.00	0.01	0.19	0.03	TAM96=0.04;SIN95=0.96
AEL96	0.355	-2.84	0.00	0.07	0.00	0.07	0.00	0.10	SIN93=0.72;TAM96=0.09;AI296=0.11;BRN94=0.08
AI296	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	AI296=1.00
AIC96	0.274	-3.99	0.00	0.09	0.00	0.07	0.00	0.08	TAM96=0.10;SIN94=0.74;BRN94=0.15;SIN93=0.01
AIZ96	0.701	-0.66	0.00	0.04	0.00	0.03	0.19	0.04	TAM96=0.12;SIN94=0.72;BRN94=0.16
AIB96	0.600	-1.20	0.00	0.04	0.08	0.01	0.12	0.01	SIN93=0.16;BRN94=0.84
ALA96	0.356	-3.09	0.32	0.05	0.00	0.02	0.00	0.00	AI296=0.06;SIN93=0.38;BRN94=0.44;BRN93=0.12
AMW96	0.585	-1.08	0.03	0.09	0.09	0.06	0.00	0.06	SIN93=0.68;BRN93=0.32
AMR96	0.470	-1.91	0.23	0.05	0.00	0.00	0.00	0.00	SIN93=0.55;AI296=0.30;BRN93=0.05;BRN94=0.10
ANS96	0.083	-23.94	0.59	0.11	0.00	0.13	0.77	0.32	TAM96=0.72;SIN95=0.28
BRA96	0.461	-1.67	0.02	0.09	0.05	0.06	0.00	0.05	SIN93=0.81;BRN93=0.19
BRI96	0.440	-1.96	0.00	0.07	0.00	0.07	0.03	0.09	BRN94=0.01;TAM96=0.20;SIN94=0.79
CAT96	0.550	-1.17	0.18	0.03	0.00	0.02	0.37	0.07	SIN95=0.89;TAM96=0.11
CHI96	0.556	-1.07	0.00	0.09	0.05	0.08	0.07	0.07	BRN94=0.06;SIN93=0.94
CON96	0.297	-6.33	0.60	0.06	0.00	0.08	0.56	0.28	TAM95=0.17;TAM96=0.83
DEL96	0.398	-2.77	0.87	0.04	0.06	0.03	0.00	0.06	BRN93=0.76;SIN93=0.24
EMI96	0.304	-3.06	0.00	0.09	0.00	0.04	0.03	0.03	SIN93=0.62;BRN94=0.07;SIN94=0.31
FED96	0.654	-0.90	0.00	0.05	0.00	0.03	0.78	0.00	AI296=0.01;SIN93=0.43;TAM96=0.01;BRN93=0.56
FIN96	0.630	-0.89	0.00	0.06	0.00	0.05	0.05	0.03	SIN93=0.32;BRN94=0.35;SIN94=0.33
LUF96	0.556	-1.55	1.05	0.01	0.02	0.03	0.00	0.08	BRN93=0.92;SIN93=0.08
MAR96	0.361	-2.30	0.07	0.15	0.10	0.08	0.22	0.07	SIN93=1.00
QAN96	0.375	-2.38	0.06	0.08	0.00	0.04	0.00	0.03	SIN93=0.82;BRN93=0.18
SAS96	0.556	-1.20	0.00	0.06	0.00	0.06	0.11	0.05	SIN94=0.72;BRN94=0.23;TAM96=0.05

Appendix 1 – Selected Air Transport Companies - DEA VRS Model Input Oriented – 1993, 1994, 1995 e 1996 (continued)

	<i>Inefficiencies</i>								
<i>DMU</i>	<i>q</i>	$I_{FL}^-$	$I_{TA}^+$	$I_{NM}^+$	$I_{ROE}^+$	$I_{OM}^+$	$I_{NAT}^+$	$I_{RONA}^+$	<i>I</i>
<i>SIN96</i>	0.928	-0.10	0.02	0.01	0.01	0.03	0.03	0.03	<i>SIN95=1.00</i>
<i>STH96</i>	0.656	-0.79	0.00	0.06	0.00	0.02	0.03	0.00	<i>AI296=0.10; SIN95=0.74; BRN93=0.16</i>
<i>TAM96</i>	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	<i>TAM96=1.00</i>
<i>THA96</i>	0.303	-3.07	0.00	0.10	0.00	0.01	0.16	0.02	<i>SIN95=0.97; BRN96=0.01; TAM96=0.02</i>

## Appendix 2 – Initials, Name and Country of Origin of Selected Airline Companies

<i>INITIALS</i>	<i>COMPANY NAME</i>	<i>COUNTRY OF ORIGIN</i>
AEL	Aer Lingus	Ireland
AI2	Air 2000	United Kingdom
AIC	Air Canada	Canada
AII	Air India	India
AIZ	Air New Zealand	New Zealand
AIB	Airborne Express	USA
ALA	Alaska Air Group	USA
AMW	America West Airlines	USA
AMR	AMR Corp	USA
AMT	Amtran-American Trans Air	USA
ANS	Ansett Australia Holdings	Australia
BRA	Braathens Safe	Norway
BRN	Britannia Airways	United Kingdom
BRI	British Airways	United Kingdom
CAT	Cathay Pacific Airways	Hong Kong
CHI	China Airlines	Taiwan
CON	Continental Airlines	USA
DEL	Delta Air Lines	USA
EMI	Emirates Airline	United Arab Emirates
FED	Federal Express Corp	USA
FIN	Finnair	Finland
KLM	KLM-Royal Dutch Airlines	The Netherlands
KOR	Korean Air	Korea
LOT	LOT Polish Airlines	Poland
LUF	Lufthansa German Airlines	Germany
MAL	Malaysia Airlines	Malaysia
MAR	Martinair Holland	The Netherlands
MON	Monarch Airlines	United Kingdom
QAN	Qantas	Australia
SAS	Scandinavian Airlines System	Sweden
SIN	Singapore Airlines	Singapore
STH	Southwest Airlines	USA
SWI	Swissair	Switzerland
TAM	TAM Linhas Aéreas Regionais	Brazil
THA	Thai Airways International	Thailand