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Malmquist financial efficiency analysis for airlines

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ABSTRACT

This article discusses the financial efficiency of 42 airlines from 25 countries, in 2001 (the year of the September 11 terrorist attack in the United States), and their profitability in the following year. The Malmquist index was used to indicate the airlines' capital structure changes from 2001 to 2002. The results show airline capital structure management and profitability dynamics following the unexpected event of 2001. The main conclusion is that airlines which moved more intensively to reduce their indebtedness showed improved profitability, given their size, fleet and intangible assets.

1. Introduction

The air transport industry has unique characteristics that require company managers and shareholders to make strategic decisions influenced by a variety of factors. Governments raise barriers to competition on routes whether international, domestic or regional. Factors such as airspace and airport capacities, operating safety and international agreements influence government decisions on awarding routes. In order to establish air transportation operations and to grow, airlines require substantial financial investment, especially in aircraft, fleet maintenance and information systems. To meet passenger and cargo demand properly, the system must have an equilibrium that reconciles these and other factors, such as operating costs and expenses, fleet suitability to each route and company profitability. Despite the global deregulation movement, high barriers to entry remain in the air transportation industry, particularly in domestic air transportation markets.

Decisions on capital structure are strategic and involve the choice of whether to fund investments through debt and/or equity. The cost of debt financing may be lower than that of equity financing; however any relative increase in third-party debt represents an added financial risk, given its higher enforceability. Debt financing meets its limit when financial risk entails risk of bankruptcy. In the air transportation industry, managers have taken a variety of approaches to company debt levels. In capital structure theory, the static trade-off model defines a balance between the cost of a source of funding and the risk of bankruptcy (Modigliani and Miller, 1958, 1963; Myers, 1977).

Miao (2005) observes that industries with high entry costs have high average indebtedness and low turnover. These characteristics appear to be consistent with what is observed in the aviation industry, where some companies are in negative equity. This means no funds are derived from shareholders and the financial structure is based on debt. Guzhva and Pagiavlas (2003), analyzing the US air transportation industry before and after deregulation, find that firms generally maintain high indebtedness regardless of economic cycles. Opler and Titman (1994) find that, during market contractions, highly leveraged firms lose substantial market share to their more conservatively financed competitors (nearly 26% in relation to companies with low indebtedness). These findings are consistent with the view that the indirect costs of financial distress are significant

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and positive. Harris and Raviv (1990) find that innovations in bankruptcy law have reduced bankruptcy costs and, to a certain extent, helped firms filing for bankruptcy to recover.

Gong (2007) discusses bankruptcy protection under US law and points to the fact that over 160 US carriers have filed for bankruptcy since deregulation in 1978, many of them filing recurrently for Chapter 11 protection. There is a controversy over whether Chapter 11 reorganization is an artificial, indirect subsidy, allowing weak companies to operate in the market. This study also identified positive changes in the stock prices of companies surviving Chapter 11 reorganization (500% on average within 3 years of filing for bankruptcy). Rivals also experienced gains during this period, possibly owing to the possibility of healthy rivals acquiring weak airlines. These results are consistent with the views of Jensen and Meckling (1976). They argue that bankruptcy costs themselves are unlikely to be the major determinant of corporate capital structures, and that one possible explanation for this phenomenon is that firms are using mergers to avoid the costs of bankruptcy. Broadie et al. (2007) examine cases of companies that filed for Chapter 11 and Chapter 7 bankruptcy. They conclude that both lenders and borrowers gain from reorganization and therefore this situation is preferable to liquidating the company.

Because changes occur in the economic environment surrounding companies, it is important that the financial decisions made are consistent with a level of financial risk that will not prevent the company from maintaining operations and successfully competing in the market. According to portfolio theory, it is impossible for airline companies to eliminate systematic risk, such as the September 11 attacks. Companies operating at risk of bankruptcy become vulnerable when unpredicted events such as this occur. This article examines the responses of airline companies from 2001 to 2002, considering their capital structure and the impact this event had on the entire industry.

It is thus a financial analysis of the companies, relating to the level of indebtedness, the size, the tangibility of assets, and the return on assets. Given that, in the literature, these variables are related to capital structure choice, this study examines whether the financial decision as to the amount of third party capital, and on the other hand, the level of shareholders' capital, in the capital structure changed from 2001 to 2002, considering the other variables, the intangible assets, and the growing risk of bankruptcy. In other words this paper asks whether shareholders understood the turbulent times and reacted to them quickly, helping the company with new capital.

Most countries have a few carriers, and to lose a company because of poor or short-sighted management is not good for passengers or government. Despite the division of the market, and the high barriers to entry, which make it a relatively secure market to operate in, companies face the challenge of making financial decisions consistent with their responsibility to supply transport. The vulnerability of the air transport industry to unexpected events, like September 11, shows the need for specific studies of how airlines react and what the consequences are. This paper intends to add knowledge in the field of airline financial efficiency, by considering a dynamic view of the unforeseen event.

2. Data envelopment analysis (DEA) and the Malmquist index

Data envelopment analysis is a nonparametric model based on linear programming that measures the efficiency of a sample based on the ratio of inputs to outputs, with two basic objectives: minimizing inputs or maximizing outputs. The efficient frontier is a hyperplane (in the case of more than two variables) formed by the decision-making units (DMUs) which, on the selected model, have the best input-to-output ratio. The DMUs considered inefficient are analyzed and indications are made of how they may reach the frontier.

The Malmquist index compares company efficiency between two periods of time (a single input and output case is illustrated in Fig. 1). It is defined as the product of "catch-up" and "frontier-shift". The catch-up term relates to the DMU's efforts to improve its efficiency, while the frontier-shift term reflects change in the efficient frontiers surrounding the DMU between the two time periods 1 and 2.

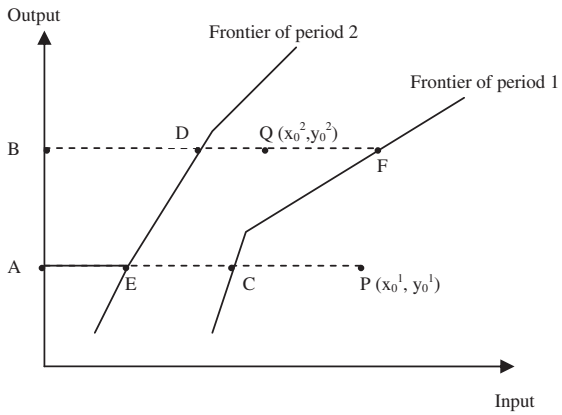

Fig. 1. DEA Malmquist index.

The catch-up effect (in input-orientation) can be computed as:

$$\text{Catch-up} = \frac{BD}{BQ} \Big/ \frac{AC}{AP} \tag{1}$$

(Catch-up) > 1 indicates progress in relative efficiency from period 1 to 2, while (catch-up = 1) and (catch-up) < 1 indicate the status quo and decline in efficiency, respectively.

The frontier-shift effect at (x_0^1, y_0^1) is evaluated by:

$$\text{Frontier-shift} = \frac{AC}{AE} \tag{2}$$

(Frontier-shift) > 1 indicates progress in the total factor productivity of the DMU_0 from period 1 to 2, while (frontier-shift = 1) and (frontier-shift) < 1 indicate respectively the status quo and decay in total factor productivity.

The Mamquist index represents the DMU's total factor productivity, in that it reflects progress or decline in the DMU's efficiency, together with progress or decay in the frontier technology. See Greer (2008) and other authors cited by him for further details on the Malmquist index.

3. Data

The study involved 42 publicly-held airline companies during 2001 and 2002. The sample included government- and privately-owned companies from 25 countries. The subject data was calculated from company balance sheets and financial statements provided by Milne (2002) in conformity with globally accepted accounting standards and the requirements prescribed by the International Air Transport Association (IATA). For the years 2001 and 2002, respectively, these companies posted total net revenues of US$ 200.434 billion and US$ 211.117 billion and total assets of US$ 267.224 billion and US$ 276.311 billion, at current value, while return on assets for these respective years was −83% and −13%. Although they experienced 5% growth in net sales, asset performance was negative, but showed a recovery trend from 2001 to 2002.

DEA modeling limits inclusion of negative DMU variables. Table 1 shows the companies that were eliminated each year because of negative equity. This is computed as a percentage of total assets. These companies had negative return on assets during these years.

4. Variables and approach

Research relating to capital structure theory has attempted to identify relevant factors in business financing and to build hypotheses on the reasons surrounding them. It is believed that fixed assets, non-debt tax shields, investment opportunities, firm size, volatility, advertising expenditures, probability of bankruptcy, profitability and uniqueness of the product are factors that influence the choice of capital structure (Harris and Raviv, 1991). These factors have been tested in more than one formulation to identify an explanatory or cause-effect relationship attributable to these variables.

In this study, financial leverage is the ratio of total assets to equity. This form of measuring indebtedness has been chosen to emphasize the share of equity in total funding, which is evidence of shareholders' involvement in the business and how confident they are in it and support it financially.

The broad range of companies in the sample may raise questions as to whether or not precise measurements can be made. However, Rajan and Zingales (1995) find no significant differences in indebtedness among bank-oriented (Japan, Germany, Italy, and France) and market-oriented (United States, United Kingdom, and Canada) G7 countries. Another peculiarity of this study is the calculation of variables by book value and not market value. Of course tests involving market value would have been useful, but the limited information disclosed by companies required we use this measure. Booth et al. (2001),

Table 1
Data on companies not included in the sample due to negative equity.

Company	Year	Negative equity (%)	Net revenue US$ billions	Tangibility of assets (%)	ROA (%)
Air Canada	2001	11	6.205	32	−20
Northwest	2001	3	9.905	51	−3
US Airways	2001	33	8.288	57	−27
Varig	2001	13	2.578	18	−12
Air Canada	2002	31	6.269	31	−18
Amtran	2002	14	1.277	31	−21
Northwest	2002	17	9.489	55	−6
South African	2002	9	1.714	63	−38
UAL	2002	10	14.286	69	−14
US Airways	2002	75	6.977	60	−25

comparing the level of indebtedness of 10 developing countries and of G7 countries, find that nearly all developing countries have lower debts than the average for developed countries, regardless of whether book value or market value is considered.

Firm size is computed as the natural logarithm of net sales. Ferri and Jones (1979) find a positive relationship, as do Rajan and Zingales (1995), for all G7 countries except Germany. This is explained by the fact that large companies have greater access to a variety of sources of capital, are more diversified, and are less likely to fail. Low expected bankruptcy costs allow higher leverage. Titman and Wessels (1988) find evidence that small companies tend to use significantly more short-term debt than large companies, which prefer long-term financing. This possibly reflects the higher transaction costs for small companies issuing long-term debt or increasing share capital.

Tangibility of assets is the ratio of fixed to total assets. Harris and Raviv (1990) and Thies and Klock (1992) find asset tangibility to be positively related to leverage. Rajan and Zingales (1995) derive the same finding from their research for all G7 countries, considering both book value and market value. Titman and Wessels (1988) find no significant statistics in their tests, while Ferri and Jones (1979) find a negative relationship. In principle, the existence of tangible assets provides greater security to debtholders, as assets serve as a security for debt contracts.

Profitability is net profit to total assets (ROA). Titman and Wessels (1988) and Thies and Klock (1992) find profitability to be negatively related to leverage. Myers and Majluf (1984) find that profitable companies choose not to borrow externally and prefer internal financing. Adding to this argument, Jensen (1986) says managers prefer to avoid debt and the discipline it imposes. In Rajan and Zingales (1995), profitability is negatively correlated with leverage in all G7 countries except Germany and is economically insignificant in France. Toy et al. (1974) find profitability to be positively related to leverage. Gritta (1979) researches the relationship between return on equity and leverage in the air transportation industry and finds it to be positive. Chin and Tay (2001), researching Asian airlines, conclude that the most profitable companies have a higher probability of survival, which increases with company size. Their study suggests development of prediction methods, flexible capacity and responsiveness to changes in the environment. Morrell (2007) points out that intangible assets are an important factor in airlines' capital structure.

These studies test various methods of measuring relations between capital structure variables in different contexts, seeking to find a general rule that defines the issue. The present study seeks to add a dynamic view of the relationship between variables under the influence of unexpected events. It accepts that the relationship exists and seeks to address the question of how improvements – i.e. relative reductions of indebtedness to assets (leverage) – would result in improvements in profitability, given airlines' size (revenue), tangible (fleet) and intangible assets (registered by book value). So, in this paper, DEA application of Malmquist index from 2001 to 2002 will consider airlines' leverage as input for minimization, given revenue, fleet value and intangible asset value as outputs in a model of variable returns to scale. The Malmquist index and its components will serve as proxies for each airline's efforts to reduce its indebtedness in the period. The variation in return on assets (ROA) from 2001 and 2002 will give the airlines' profitability improvements.

5. Case study

Financial leverage was treated as an input (one input) and firm size, tangibility of assets, and intangible assets were treated as outputs (three outputs). An input minimization, variable-returns-to-scale model was used, as the sample contains companies of varying sizes.

DEA supports only positive values. Therefore the variables selected for the model could not include return on assets (many companies reported net losses during the study period), otherwise the sample would be too small. For the purpose of analysis, Tables 3 and 4 present the results of the DEA frontier for 2001 and 2002, the Malmquist index estimations and return on assets for the subject companies. We show the DEA Scores (Table 3) revealing the position of airlines in relation to the frontier each year. Although the DEA Scores do not show a relative position improvement or deterioration, the Malmquist index does. In fact Table 3 shows that airlines with Malmquist indices greater than 1 have higher positive change in ROA (ROA 2002–2001) than those with less than 1. The positive change totals 109.19, while the negative change totals −11.72. Airlines with Malmquist indices equal to or lower than 1 showed change of 22.07 positive and −49.64 negative. This suggests the positive impact of reducing indebtedness on variation in ROA. The correlation between Malmquist indexes and improvement in ROA is 30%. Although this is not a strong correlation it is positive.

Table 2 summarizes key findings. Most companies with a Malmquist index greater than 1 derived funding from equity, thus reducing their leverage and financial risk. In this group, 64% had better return on assets than firms with Malmquist index equal or lower than 1. Federal Express and All Nippon Airlines increased their indebtedness.

Table 2
Malmquist efficiency tests.

Results	Number of companies	Increased share capital (%)	Growth of ROA (%)	Increased size (%)	Reduced tangibility of assets (%)
Malmquist > 1	25	84	64	69	69
Malmquist ⩽ 1	17	18	53	76	54

This inverse relationship between indebtedness and profitability is consistent with pecking order theory and supported by various empirical studies. There is, however, a controversy in relation to the trade-off theory argument that an increase in profitability is followed by a decrease in distress costs and the company would choose to obtain tax benefits by increasing indebtedness. Strebulaev (2007) uses a dynamic model to question the tests performed to determine the best capital structure, and argues that expected profitability is positively related to leverage at the refinancing points, but that the accepted tests fail to take financing adjustments into consideration, rather considering that an increase in profitability lowers leverage by increasing future profitability and thus the value of the firm. This seems to imply a negative relationship, but in fact fails to take refinancing decisions into consideration.

Harford et al. (2009) study the debt of 1188 companies that made acquisitions, concluding that a leverage target exists, as do Kayan and Titman (2007) when examining cash flows, investment expenditures, and stock prices. They advocate the tradeoff theory of capital structure.

Table 2 shows that companies with a Malmquist index equal or lower than 1 had poorer performance than the other group. Most increased their indebtedness and therefore their financial risk, except British Airways, Malaysia Airlines and Singapore Airlines.

Table 3 shows that Japan Airlines had the highest Malmquist index. This is due to a high relative decrease of indebtedness accompanied by growth in net revenue and tangible assets. A similar case is that of TAP.

Airlines with a "catch-up" index greater than 1 were the ones that mostly showed relative changes in the variables toward the frontier from 2001 to 2002. They were also mostly companies with a Malmquist index higher than one.

Table 3
DEA Scores, Malmquist index and return on assets for airlines, 2001 and 2002.

Decision-making units	DEA Score 2001 (%)	DEA Score 2002 (%)	Catch-up	Frontier-shift	Malmquist	ROA 2001 (%)	ROA 2002 (%)	ROA (2002–2001)	Growth (+) and decrease (−) of ROA
Japan	50.49	100.00	7.588	0.473	3.591	−1.57	−0.23	1.34	+
TAP	0.53	1.72	3.254	1.079	3.509	−2.79	−0.46	2.33	+
Air New Zealand	11.91	37.68	3.165	1.093	3.458	−17.55	−8.20	9.35	+
Federal Express	100.00	100.00	5.068	0.574	2.910	4.45	3.93	−0.52	−
Jet Blue	59.11	100.00	3.394	0.689	2.337	5.79	3.55	−2.24	−
Gulf Air	9.30	19.14	2.059	1.050	2.162	−10.16	−7.99	2.17	+
Austrian	24.68	64.69	2.621	0.806	2.113	−4.00	1.13	5.13	+
Thai	16.09	27.10	1.684	1.197	2.016	0.18	8.95	8.77	+
AirTran	14.08	17.60	1.250	1.314	1.642	−0.60	2.33	2.93	+
Alitalia	35.42	52.66	1.487	1.097	1.631	−20.18	1.63	21.81	+
Air France	61.14	95.63	1.564	1.023	1.601	1.14	0.95	−0.19	−
Virgin	17.58	24.39	1.387	1.045	1.449	−8.45	2.32	10.77	+
Lufthansa	40.81	46.06	1.129	1.205	1.360	−3.48	4.00	7.48	+
Cintra	74.50	100.00	1.642	0.771	1.267	−7.21	−8.29	−1.08	−
Ibéria	43.40	45.47	1.048	1.139	1.193	0.68	3.20	2.52	+
Aer Lingus	25.11	29.06	1.157	1.016	1.176	−9.53	2.52	12.05	+
Southwest	85.35	85.76	1.005	1.101	1.106	5.68	2.69	−2.99	−
Qantas	50.60	50.53	0.998	1.098	1.097	3.32	2.91	−0.41	−
Emirates	43.30	44.13	1.019	1.069	1.090	3.99	6.44	2.45	+
Mesa	46.30	39.21	0.847	1.262	1.069	−11.56	−2.56	9.00	+
EasyJet	92.81	100.00	1.078	0.981	1.057	7.52	4.63	−2.89	−
Cathay	81.93	76.40	0.933	1.085	1.012	0.94	5.56	4.62	+
Delta	100.00	100.00	1.017	0.992	1.009	−5.15	−5.21	−0.06	−
All Nipon	18.64	17.90	0.961	1.047	1.006	−0.62	−1.96	−1.34	−
Korean	69.29	61.78	0.892	1.122	1.001	−5.40	1.06	6.46	+
AMR	100.00	100.00	1.000	1.000	1.000	−5.37	−11.60	−6.23	−
Lan Chile	38.03	33.06	0.869	1.131	0.983	0.77	1.96	1.19	+
Ryanair	78.33	81.20	1.037	0.944	0.979	7.95	9.72	1.77	+
SAS	46.80	41.73	0.892	1.088	0.970	−1.69	−0.20	1.49	+
Atlantic Coast	75.83	74.26	0.979	0.989	0.968	7.51	6.79	−0.72	−
British	100.00	100.00	1.000	0.965	0.965	−1.04	0.56	1.60	+
SkyWest	100.00	100.00	0.888	1.032	0.916	6.86	8.71	1.85	+
China Southern	100.00	100.00	1.000	0.887	0.887	1.11	1.56	0.45	+
KLM	42.32	32.21	0.761	1.097	0.835	−1.72	−5.09	−3.37	−
Alaska	48.29	37.58	0.778	1.048	0.815	−1.36	−4.13	−2.77	−
Malaysia	100.00	73.98	0.740	1.038	0.768	−5.66	5.91	11.57	+
Swiss	84.33	60.34	0.715	1.043	0.746	−8.07	−21.00	−12.93	−
Singapore	100.00	100.00	0.464	1.531	0.711	3.40	5.55	2.15	+
Frontier	93.18	44.34	0.476	1.320	0.628	3.86	−3.92	−7.78	−
Continental	24.50	13.63	0.556	1.075	0.598	−0.97	−4.11	−3.14	−
China Eastern	71.42	43.56	0.610	0.741	0.452	1.88	0.28	−1.60	−
America West	100.00	7.54	0.075	1.136	0.086	−15.86	−26.96	−11.10	−

Table 4
Malmquist index statistics and return on assets for airlines, 2001 and 2002.

Statistics	Catch-up	Frontier-shift	Malmquist	ROA 2001 (%)	ROA 2002 (%)
Average	1.454	1.033	1.337	−1.98	−0.31
Maximum	7.588	1.531	3.591	7.95	9.72
Minimum	0.075	0.473	0.086	−20.18	−26.96
Standard deviation	1.346	0.190	0.807	6.73	7.27

The "frontier-shift" index returned high average values and low standard deviation (see Table 4), indicating a high level of technological development, can be interpreted as the response by the sample of companies analyzed to the September 11 attacks.

Greer (2008), examining changes in productivity of major United States airlines calculated through nonfinancial indexes, finds that there were more improvements in efficiency toward the frontier (catch-up index) than in technology (frontier-shift index). The results of the present study differ from those of Greer, finding that there were more airlines improving in technology than in catch-up.

Analysis without the intangible assets found nearly the same results as those in Table 3. The exceptions were Cintra and Delta Airlines that went to the group of the Malmquist index equal or lower than 1. In a context of 42 companies that represents error of 4.76%. These two carriers are positioned in the group of the highest Malmquist index (Table 3).

6. Conclusion

This paper examines the capital structure of airlines in relation to the unexpected September 11 attacks in the United States. Because this was a systematic risk, many companies responded by increasing the portion of equity in their total financing, thereby decreasing their financial risk. Of these, 64% improved their profitability. In contrast, 53% of the airlines that did not improve the ratio of equity to third-party financing had poorer performance. Nevertheless, our findings are that most airlines increased in size (i.e. net revenue), relatively decreased their fixed assets (aircraft), and increased their intangible assets. Although this is not a definitive conclusion, airline company sustainability can be said generally to be associated with a conservative stance on leverage and regulations to safeguard companies against unexpected events.

The airlines' financial movements observed in response to the unexpected event of September 11 in the United States are suggestive of a leaseback operation, which decreases fixed assets and increases profitability (by boosting net return compared with total assets), and also increases net revenue. In these turbulent times, it is reasonable for some airlines to sell aircraft to boost liquidity. This paper's main contribution to the literature is intended to be a dynamic view of the capital structure approach. For future research a broad analysis of factors that drive airline financial efficiency would clarify the relationships among the variables.

References

Booth, L., Aivazian, V., Demirguc-Kunt, A., Maksimovic, V., 2001. Capital structure in developing countries. The Journal of Finance 61 (1), 87–129.
Broadie, M., Chernov, M., Sundaresan, S., 2007. Optimal debt and equity values in the presence of chapter 7 and chapter 11. The Journal of Finance 62 (3), 1341–1377.
Chin, A.T.H., Tay, J.H., 2001. Developments in air transport: implications on investment decisions. Profitability and survival of Asian airlines. Journal of Air Transport Management 7 (5), 319–330.
Ferri, M., Jones, W., 1979. Determinants of financial structure: a new methodological approach. The Journal of Finance 34 (3), 631–644.
Gong, S.X.H., 2007. Bankruptcy protection and stock market behavior in the US airline industry. Journal of Air Transport Management 13 (4), 213–220.
Greer, M.R., 2008. Nothing focuses the mind on productivity quite like the fear of liquidation: changes in airline productivity in the United States 2000–2004. Transportation Research Part A 42 (2), 414–426.
Gritta, R.D., 1979. The effect of financial leverage on air carrier earnings: a break-even analysis. Financial Management Association 8 (2), 53–60.
Guzhva, V., Pagiavlas, N., 2003. Corporate capital structure in turbulent times: a case study of the US airline industry. Journal of Air Transport Management 9 (6), 371–379.
Harford, J., Klasa, S., Walcott, N., 2009. Do firms have leverage targets? Evidence from acquisitions. Journal of Financial Economics 93 (1), 1–14.
Harris, M., Raviv, A., 1990. Capital structure and the informational role of debt. The Journal of Finance 45 (2), 321–349.
Harris, M., Raviv, A., 1991. The theory of capital structure. The Journal of Finance 46 (1), 297–355.
Jensen, M.C., 1986. Agency costs of free cash flow. Corporate finance and takeovers. American Economic Review 76 (2), 323–339.
Jensen, M.C., Meckling, W.H., 1976. Theory of the firm: managerial behavior agency costs and ownership structure. Journal of Financial Economics 3 (4), 305–360.
Kayan, A., Titman, S., 2007. Firms' histories and their capital structures. Journal of Financial Economics 83 (1), 1–32.
Miao, J., 2005. Optimal capital structure and industry dynamics. The Journal of Finance 60 (6), 2621–2659.
Milne, I., 2002. Getting Results: Airline Financial Profiles. Airline Business, Reed Business Information, Sutton, Surrey.
Modigliani, F., Miller, M., 1958. The cost of capital. Corporation finance and the theory of investment. The American Economic Review 48 (3), 261–297.
Modigliani, F., Miller, M., 1963. Corporate income taxes and the cost of capital: a correction. The American Economic Review 53 (3), 433–443.
Morrell, P.S., 2007. Airline Finance, third ed. Ashgate, Aldershot.
Myers, S., 1977. Determinants of corporate borrowing. Journal of Financial Economics 5 (2), 147–175.
Myers, S.C., Majluf, N.S., 1984. Corporate financing and investment decisions when firms have information that investors do not have. Journal of Financial Economics 13 (2), 187–221.
Opler, T.C., Titman, S., 1994. Financial distress and corporate performance. The Journal of Finance 49 (3), 1015–1040.
Rajan, R.G., Zingales, L., 1995. What do we know about capital structure? Some evidence from International data. The Journal of Finance 50 (5), 1421–1460.

Strebulaev, I.A., 2007. Do tests of capital structure theory mean what they say? The Journal of Finance 62 (4), 1747–1787.
Thies, C.F., Klock, M.S., 1992. Determinants of capital structure. Review of Financial Economics 2 (1), 40–52.
Titman, S., Wessels, R., 1988. The determinants of capital structure choice. The Journal of Finance 43 (1), 1–19.
Toy, N., Stonehill, A., Remmers, L., Wright, R., Beekhuisen, T., 1974. Comparative international study of growth, profitability, and risk as determinants of corporate debt ratios in the manufacturing sector. Journal of Financial and Quantitative Analysis 9 (5), 875–886.