Applying Z-score Models in Aviation Finance Education: A Case Study of Some US Carriers

Chris C. Hsu, Ph.D.
Director, CUNY Aviation Institute
York College, City University of New York, U.S.A

Abstract

Bankruptcy is an important topic in aviation finance education. However, aviation finance textbooks pay little attention to this topic. To address this gap, this article presents the application of the Z-score model developed by Altman. Selecting American Airlines and Southwest Airlines as case studies, we compared the empirical results to prove the efficiency of utilizing the Z-score model. Our findings suggest that the Z-score model is a reliable predictor of bankruptcy and should be included not only in aviation finance education at the undergraduate level but other areas of corporate finance as well.

Keywords: Bankruptcy, Z-score

1. Introduction

Bankruptcy is an essential topic in finance. After deregulation of the aviation industry in 1978, many airlines could not survive the steep competition, harsh economic cycles, and fuel cost fluctuations and filed for bankruptcy protection. According to Ciliberto and Schenone (2012), between 1992 and 2007, more than 30 bankruptcy protections in the airline industry were filed under Chapter 7 or 11 of US Bankruptcy Law. Because the aviation industry is highly labor- and capital-intensive and is intensively watched by the financial markets, a bankruptcy announcement can trigger serious impacts on the stock prices of not only the bankrupt airline but of all airlines (Gong, 2007). Therefore, it is important to include the topic of bankruptcy prediction in aviation finance education so that students and practitioners will be able to apply the techniques in their practice.

Current aviation finance textbooks place little emphasis on the topic of bankruptcy prediction. One possible explanation could be that there are many sophisticated models in the literature, such as the hazard model introduced by Shumway (2001), the neural network approach suggested by Davalos, Gritta and Chow (1999), and the Correlated Credit Components approach developed by Parnes (2012), but those models are too complicated to introduce in aviation finance courses at undergraduate level. However, the Z-score models proposed by Altman to predict the possibility that a company will file bankruptcy within a year are relatively easy to apply and feasible to adopt in aviation finance education.

Altman first introduced his Z-score model in 1968. The model is a linear equation formulated from five ratios: $\frac{working\ capital}{total\ assets}$, $\frac{retained\ earnings}{total\ assets}$, $\frac{EBIT}{total\ assets}$, $\frac{market\ value}{total\ libilities}$, and $\frac{sales}{total\ assets}$. The main elements of the Z-score model are working capital, retain earnings, earning before interests and taxes (EBIT), total market values, sales, total assets, and total liabilities. This model is relatively easy to calculate, and the data required for the equation can be easily found from a company's financial reports. Since the model was first introduced, it has been widely employed. A drawback of this 1968 model, however, is that one element is the market value of a company. Since a company's market value is the market price per share multiplied by the number of shares outstanding, the application of this 1968 model is limited to companies listed on stock markets. Privately traded companies lack a market price and thus are inappropriate for this model. To address this limit, Altman revised the model in 1983, replacing market value with book value (Altman, 1993, 2000).

Compared to other complicated mathematic models, the series of Altman Z-score models is easier to understand. Instructors of aviation finance courses can easily design a Microsoft Excel template and introduce this model at the undergraduate level.

This article aims to explain how Altman's Z-score models can be included in an aviation finance course. Specifically, we will use the data of American Airlines and Southwest Airlines to illustrate the application of the Z-score models. Our presentation will focus only on Altman's original 1968 model, because airlines are all publicly traded companies and the market value will provide fairer judgment than the book value. The remainder of this article will proceed as follows: the next session explains the models, Section 3 discusses the model's application, and Section 4 presents the conclusion.

2. The Z-score Models

The 1968 Model

According to Altman (1968), the Z-score model for bankruptcy prediction is defined as follows:

$$Z = 1.2\alpha + 1.4\beta + 3.3\gamma + 0.6\delta + 0.999\theta$$

$$\alpha = \frac{working\ capital}{total\ assets}$$

$$\beta = \frac{retained\ earnings}{total\ assets}$$

$$\gamma = \frac{EBIT}{total\ assets}$$

$$\delta = \frac{market\ value}{total\ libilities}$$

$$\theta = \frac{sales}{total\ assets}$$

Working capital is defined as current assets minus current liabilities.

The thresholds of the bankruptcy prediction results are defined as follows:

Z < 1.81 Insolvency area, the company has a very high chance of experiencing bankruptcy;
1.81 < Z < 2.99 Gray area, whether the firm will file bankruptcy is uncertain; and
Z > 2.99 Low-risk area, the firm has a healthy financial situation.

3. Empirical Application

To demonstrate the application of the Z-score model, we selected two airlines: American Airlines, which filed for bankruptcy protection on November 29, 2011, and Southwest Airlines, which will serve as the control. The financial data were extracted from the two companies' 10K reports of 2009 and 2010, the two years prior to American Airlines' bankruptcy filing. Empirical results are reported in Table 1.

Table One: Z-score results of American Airlines and Southwest Airlines				
	American Airlines		Southwest Airlines	
	2009	2010	2009	2010
Sales	19917	22170	10,350	12,104
EBIT	-1004	308	262	998
current assets	6642	6838	3358	4279
current liabilities	7728	8780	2695	3305
Total assets	25438	25088	14269	15463
Total liabilities	28927	29033	8815	9226
Retained earnings	0	0	4971	5399
market value	1642.6463	3389.0289	9231.001	10482.799
α	-0.0427	-0.0774	0.0465	0.06299
β	0	0	0.3484	0.3492
γ	-0.0395	0.0123	0.0184	0.0645
δ	0.0568	0.1167	1.0472	1.1362
θ	0.7830	0.8837	0.7253	0.7828
Z Score	0.6348	0.9005	1.9570	2.2411
Interpretation	High risk	High Risk	Gray Area	Gray Area

According to Table 1, the performance of both companies was poor in 2009 and improved from 2009 to 2010, especially American Airlines. The reason is that, in 2009, both companies were suffering from the 2008 financial crisis and started to catch up as the economy recovered in 2010. The earnings before interest and taxes of American Airlines were negative $1.004 billion in 2009 but turned to positive $308 million in 2010, indicating that the company had improved remarkably in promoting sales and control expenses. The zero retained earnings of American Airlines in both 2009 and 2010 suggested that the company lacked enough profits to carry over to the next fiscal year.

The five ratios of the Z-score were calculated and reported in the second portion of Table 1. This calculation can be easily conducted in Microsoft Excel. The Z-score results are reported at the bottom of Table 1. The Z-scores of American Airlines were 0.6348 and 0.9005 in 2009 and 2010, respectively. Both figures were far lower than the threshold of 1.81 and fall into the insolvency area. Although the figure increased from 0.6348 to 0.9005, that was still too low to enable American Airlines to survive. Eventually, American Airlines claimed bankruptcy on November 29, 2011.

Unlike American Airlines, Southwest Airlines had a solid financial situation. The retained earnings of Southwest Airlines improved from $4.79 billion in 2009 to $5.399 billion in 2010, and the figures of the earning before interests and taxes were boosted from $262 million to $998 million. The Z-score results were 1.9570 and 2.2411 in 2009 and 2010, respectively, which are higher than the insolvency threshold of 1.81. Although both figures were located in the gray area, the Z-score increased and moved toward 2.99, the threshold of the low-risk area, indicating that the company was in a stable financial condition. As a matter of fact, according to the report of a business insider, Southwest Airlines kept growing and, in terms of capital, ranked as the second largest airlines in the United States in 2016 (Data source: Business Insider http://www.businessinsider.com/these-are-the-7-biggest-us-airlines-2016-4/#3-american-5).

4. Conclusion

This article provides an empirical demonstration of how to include the Z-score bankruptcy prediction model in aviation finance education at the undergraduate level. Unlike many bankruptcy prediction models which utilize sophisticated mathematical methodologies, the Z-score model is a simple equation comprised of five ratios with data that can be easily found in a company's 10K reports. Using two airlines as examples, American Airlines and Southwest Airlines, we presented how the Z-score model can be utilized to predict the possibility of bankruptcy in a company. Our empirical results suggested that the Z-score model is an appropriate topic to include in undergraduate aviation finance education and can be extended to other industries

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