AN ABSTRACT OF THE THESIS OF

Pryce J. Waites for the degree of Honors Baccalaureate of Science in Accountancy presented on May 29, 2014. Title: Can Operating Leases Predict Bankruptcy in Asset-Intensive Firms?

Abstract approved: _____
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Abstract Body

Since the Altman Z-score was published in 1968, the Z-score has been a common way that investors predict bankruptcy and value risk. However, corporate structure has evolved since 1968 due to changes in economic factors and financial reporting standards. In 1976, the FASB created the first bright-line rules to distinguish between operating and capital leases. The effect of these changes on the balance sheet is not accounted for in the Altman Z-score. My theory is that distressed companies begin favoring operating leases because the footnotes are not as closely analyzed as the financial statements. In the beginning of the study, I attempt to predict bankruptcy using the Z-score for an array of asset-intensive firms. I then bring the Z-score up to date by adjusting the Altman Z-score coefficients for my sample of asset-intensive firms from a more current period. The factors included in the model remain constant, but their weighting changes due to corporate structure evolving. Lastly, I propose a model that uses the original Z-score ratios but adds operating leases to improve accuracy of bankruptcy prediction.

Keywords: bankruptcy prediction, operating leases, off-balance sheet financing

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Can Operating Leases Predict Bankruptcy in Asset-Intensive Firms?

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I understand that my project will become part of the permanent collection of Oregon State University, University Honors College. My signature below authorizes release of my project to any reader upon request.

Pryce J. Waites, Author

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Introduction

Since the turn of the century, ratio analysis has been an integral part of evaluating a firm's financial strength and profitability. This began with the current ratio to evaluate liquidity and credit-worthiness. In 1935 Smith and Winakor began studying the financial structure of unsuccessful businesses using accounting ratios (Smith & Winakor, 1935). Merwin and others began researching matched samples and accounting ratios and found these ratios were substantially different between bankrupt and non-bankrupt companies (Merwin, 1942). Since then, financial ratios have been used to evaluate both past performance and as indicators of future performance. William Beaver pioneered the univariate analysis that focused on cash flow generation and leverage (Beaver, 1966). In 1968, Edward Altman transformed the Beaver model and pioneered the Altman Z-score, which accurately predicted bankruptcy. Altman used multiple discriminate analysis and found five ratios that predicted bankruptcy most accurately (Altman, Financial Ratios, Discriminant Analysis, and the Prediction of Corporate Bankruptcy, 1968).

Since 1968, academia has continued to search for a more accurate model to predict bankruptcy (Ohlson, 1980) using hazard analysis (Shumway, 1999) and other models. These models are extremely complex and require thousands of data points but are generally very accurate at predicting bankruptcy.

With these new and more complex models, many investors continue to rely on the Altman Z-score for simplicity. This involves important financial health ratios that are frequently analyzed today. However, the Z-score was introduced in 1968, and it has not evolved to include new accounting standards. One standard that has changed since 1968 has been off-balance-sheet financing. Off-balance-sheet financing is a way a company can push debt off the balance sheet and only disclose it in the notes to the financial statements.

In 1976, the Financial Accounting Standards Board (FASB) issued Statements of Financial Accounting Standard (SFAS) No. 13 which redefined capital and operating leases (Financial Accounting Standards Board, 1976). Capital leases are considered debt and must be reported on the balance sheet, affecting debt levels. Operating leases, however, are not reported on the balance sheet and do not change the stated levels of debt in a firm. This created a way a company could potentially hide debt in an easy and convenient manner. When a company wants to keep debt levels low to reduce its cost of capital and leverage, it may be compelled to try to use off-balance-sheet operating leases. Investors must adjust their models to account for these off-balance-sheet liabilities in order to recognize the additional risk the company is exposed to. Without an accurate valuation, companies who hide debt will be considered safer, allowing them to keep their cost of borrowing and lower. This is an important factor for investors to analyze when valuing a company.

Prior to 1976, capital and operating leases were defined by Accounting Principles Board No. 5. This opinion was issued in 1964 and the language defining capital leases and operating leases allowed companies to classify leases as operating leases with ease

(American Institute of Certified Public Accountants, 2011). With the issuance of SFAS No. 13, many previously reported operating leases had to be retrospectively re-classified as capital leases. Before 1964, operating leases were not a type of lease recognition. Because the Altman Z-score was built on a sample of firms from before 1964, the corporate structure and Altman Z-score did not include any off-balance-sheet financing items and APB No. 5 can be ignored for this study. However, with SFAS No. 13, it could be seen that many companies were hiding their debt in operating leases.

Sivarama and Moyer studied the frequency of capital leases and found that within 8 years of the release of FASB SFAS No. 13, some industries had over 50% of the firms now recognizing capital leases. Sivarama and Moyer also concluded that these leases impacted capital structure and altered important ratios. The leasing firms had lower retained earnings, lower coverage ratios, higher operating risk, and a lower Z-score (Sivarama & Charles, 1994). This study shows that many companies had a significant portion of leases classified as operating leases that were substantially capital leases.

In 1995, Kirsten Ely began studying operating leases and found that financial analysts use operating leases when calculating equity risk. The market adjusts both equity risk and the debt-equity ratio for the corporation. This shows that Wall Street adjusts for these important liabilities and that these can materially impact a company's health (Ely, 1995).

It can be seen that equity risk is adjusted for operating leases. However, operating leases have not been incorporated the Altman Z-score. In this study, I attempt to examine whether operating leases can help predict bankruptcy. I do this by testing the Altman Z-score from 1968 on a sample of asset-intensive firms in a time period between 1987 and

1998. I then use a logistic regression to model a new Z-score using the same ratios that Altman used in 1968. This will adjust the Z-score for changes in corporate structure, economic factors, and other external factors for comparability purposes. I then test whether the addition of operating leases increases the prediction rate of bankruptcy. Lastly, I compare these models to find the most accurate model.

Chapter 1: The Z-score and Leases

1.1 History of Ratio Analysis

In 1935 Raymond Smith and Arthur Winakor began studying the financial ratios of businesses. They began uncovering similarities between the financial structures of unsuccessful businesses using key ratios (Smith & Winakor, 1935). With these new findings, they were able to identify important ratios that showed if a business was in distress before it went bankrupt. Over 30 years later, Edward Altman published the Altman Z-score, which was the first model to accurately predict bankruptcy in all public companies (Altman, Financial Ratios, Discriminant Analysis, and the Prediction of Corporate Bankruptcy, 1968). This became a common way for investors to evaluate the safety of their investments and to predict any future financial distress. Edward Altman also wanted the bankruptcy analysis tool to incorporate multiple financial ratios to increase prediction value.

Before 1968, the only way to predict a company's risk was to use a univariate analysis, studying individual financial ratios. The crux of the problem was not calculating the individual ratios, but interpreting what they meant. A quickly growing firm shows bad asset turnover ratios and bad cash generation ratios. Additionally, a large financially distressed company can still show strong profitability ratios and asset turnover ratios. Without the investor being skilled at analyzing all relevant ratios, ratio analysis means nothing. To benefit the investor, Altman created a multiple discriminant analysis that analyzed the ratios for the investor.

1.2 Altman Z-score

Altman used a sample of 66 corporations, split into two groups. One group was manufacturers that filed for bankruptcy between 1946 and 1965. The second group was manufacturers that did not file for bankruptcy between 1946 and 1965 and were in business for all 19 years. Altman analyzed important financial health, profitability, cash flow generation, and utilization ratios to find which were the most important to predict bankruptcy. Figure *1* shows the five most important ratios that predicted bankruptcy.

Figure 1

$$X_1 = \frac{Working\ Capital}{Total\ Assets}$$
$$X_2 = \frac{Retained\ Earnings}{Total\ Assets}$$
$$X_3 = \frac{Earnings\ Before\ Interest\ and\ Taxes\ (EBIT)}{Total\ Assets}$$
$$X_4 = \frac{Market\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Debt}$$
$$X_5 = \frac{Sales}{Total\ Assets}$$

X_1 - Working Capital/Total Assets. This is the measure of liquid assets of the firm relative to total assets (liquid and fixed). Working capital is the difference between current assets and current liabilities. For a shrinking firm, working capital tends to shrink at a fast rate as cash and inventory levels begin to fall. Fixed assets will not decrease as fast because they are not liquid and cannot be sold to raise capital quickly. Because of this, the numerator will fall at a faster rate than total assets.

X_2 - Retained Earnings/Total Assets. Retained earnings are the cumulative profit of a firm over its lifetime. As a firm approaches bankruptcy, the retained earnings will

fall faster than the total assets. When retained earnings approaches zero the business will consider bankruptcy, as owners will want to liquidate assets. One can argue that low retained earnings can be seen in relatively young firms. But when the retained earnings is compared to total assets, this accounts for firm size. A young firm will have both a low amount of retained earnings and low total assets.

X_3 - Earnings before Interest and Taxes/Total Assets. A firm's earning power is the strongest way to test financial strength. EBIT is used instead of net income because this takes out the effect of industry and prior year's performance such as deferred tax assets. EBIT is the purest form of earnings performance and focuses on operations exclusively. It is then scaled to total assets to account for firm size.

X_4 - Market Value of Equity/Book value of Total Debt. Market value of equity is the value of all stock, while debt includes current and long-term. This measure shows how much a firm's assets can decline before the liabilities exceed the value of assets and the firm is insolvent. Although market imperfections and other business factors can impact the market value of equity, these factors are similar between asset intensive firms and should not significantly impact the ratio, comparatively speaking.

X_5 - Sales/Total Assets. This ratio measures capital turnover. Capital turnover is a standard ratio that determines how management can utilize firm assets. Utilizing firm assets is important to a productive business. Because this study only analyzes asset-intensive firms, types of assets should be similar between companies.

Altman then calculated a model very similar to a logistic regression model with these five ratios that effectively predicted bankruptcy. The model is expressed below.

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + .6X_4 + .999X_5$$

After finding the Z-score, a "cut-off" score is applied to assess the financial distress of the company. Altman used a score of 2.675. For a company that had a score higher than 2.675, the model predicted that the company would not file for bankruptcy within a year. For a company that had a score of less than 2.675, the model predicted that the company would file for bankruptcy within a year.

1.3 Altman Z-score application

Using Nike, Inc.'s 2013 10-K, below is an example of how an investor can evaluate financial health using the Altman Z-score. In Table 1, Nike Inc.'s (Nike, Inc., 2013) 2013 balance sheet and income statement are presented in a consolidated format.[1] All numbers are expressed in millions of U.S. dollars.

[1] Both the Balance Sheet and the Income Statement were condensed but not changed. The full Consolidated Balance Sheet and Income Statement can be found in Appendix I.

Table 1

BALANCE SHEET	
ASSETS	
Cash and equivalents	3,337
Short-term investments	2,628
Accounts receivable	3,117
Inventories	3,434
Other current assets	1,110
Total current assets	13,626
PP&E	2,452
Goodwill	131
Other noncurrent assets	1,375
TOTAL ASSETS	**17,584**
LIABILITIES AND SHAREHOLDERS EQUITY	
Accounts payable	1,646
Accrued liabilities	1,986
Other current liabilities	294
Total current liabilities	3,926
Long-term debt	1,210
Other noncurrent liabilities	1,292
Common Stock	3
Capital in Excess of Stated Value	5,458
Retained Earnings	5,695
TOTAL LIABILITIES AND SHAREHOLDERS EQUITY	**17,584**
INCOME STATEMENT	
Sales	25,313
Cost of Sales	14,279
Operating Expenses	5,035
Other Expenses	2,709
Interest Expense	(3)
Income Tax Expense	808
Net Income	**2,485**

Using the same ratios shown in Figure *1*, the Altman Z-score is calculated below. All numbers are expressed in millions of U.S. dollars and are from Table 1.

$$X_1 = \frac{Working\ Capital}{Total\ Assets} = \frac{Current\ assets - Current\ liabilities}{Total\ Assets} = \frac{13{,}626 - 3{,}926}{17{,}584} = .552$$

$$X_2 = \frac{Retained\ Earnings}{Total\ Assets} = \frac{5{,}695}{17{,}584} = .324$$

$$X_3 = \frac{Earnings\ Before\ Interest\ and\ Taxes\ (EBIT)}{Total\ Assets}$$

$$= \frac{Net\ Income + Tax\ Expense + Interest\ Expense}{Total\ Assets} = \frac{2{,}485 + 808 + (3)}{17{,}584} = 0.187$$

$$X_4 = \frac{Market\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Debt} = \frac{Stock\ Price * Shares\ Outstanding^2}{Book\ Value\ of\ Total\ Debt} = \frac{72.92 * 878}{1{,}210} = 52.9$$

$$X_5 = \frac{Sales}{Total\ Assets} = \frac{25{,}313}{17{,}584} = 1.44$$

After all ratios are calculated, the Altman Z-score can be calculated.

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + .6X_4 + .999X_5$$

$$Z = 1.2(.552) + 1.4(.324) + 3.3(.187) + .6(52.9) + .999(1.44)$$

$$Z = 34.91$$

Analyzing Nike's Z-score for year ended May 31, 2013 shows that the risk for bankruptcy is very low. Because the cut off score is 2.675 and Nike scored 34.910, the Altman Z-score predicts that Nike will not file for bankruptcy within a year. Most companies do not score as high as Nike when calculating the Altman Z-score.

1.3 Predicting Bankruptcy since 1968

To expand on the Z-score, Edward Altman published "Predicting Financial Distress of Companies: Revisiting the Z-Score and Zeta Models" in 2000 that determined

[2] This information found elsewhere: New York Stock Exchange. (2014, 5 4). *New York Stock Exchange Quotes*. Retrieved 5 4, 2014, from http://www.nyse.com/about/listed/lcddata.html?ticker=nke

a Z-score for private firms, non-manufacturing firms, and firms in emerging markets (Altman, Predicting Financial Distress of Companies: Revisiting the Z-Score and Zeta Models, 2000). These new models applied to specific industries but he recommended the use of the original Altman Z-score for manufacturing firms.

Aside from univariate and logistic regression models, more accurate models have been created. These new models, hazard models (Shumway, 1999), are extremely complex and mostly used by banks and crediting institutions. An average investor does not have the knowledge or computing power to calculate these models. Because Altman wanted to create a model that investors could use to predict bankruptcy, I focus on the same type of model that Altman used in 1968, the logistic regression model.

1.4 Introduction to Leases

As the rules for disclosure change, the corporate structure and environment change to meet these rules and accomplish the corporate objective. It is in a corporation's best interest to meet all Securities and Exchange Commission (SEC) rules and to also keep the cost of borrowing low. Thus, as the FASB changes standards, corporations try to find ways to present their financial statements fairly, but in the most appealing way possible to keep the cost of debt low and to entice potential investors. This will also keep the cost of debt and equity low and ultimately benefit the corporation.

In 1976, the Financial Accounting Standards Board (FASB) issued Statements of Financial Accounting Standard (SFAS) No. 13 which defined capital and operating leases (Financial Accounting Standards Board, 1976). Capital leases are considered debt

and must be reported on the balance sheet, affecting debt levels. Operating leases, however, are not reported on the balance sheet and do not change the stated levels of debt in a firm. This distinction created a convenient and easy way for a company to potentially hide debt. When a company wants to keep debt levels low to reduce its cost of capital and leverage, they may be compelled to try to use off-balance-sheet operating leases.

1.5 Lease Classification

With SFAS No. 13, two types of leases were redefined: operating and capital leases. The rules that differentiate the two leases are very specific. For a capital lease, if the rental meets one of the four conditions below, it is capitalized as an asset and a corresponding liability for the future payments:

1. Ownership transfers at the end of the lease.
2. Written option for bargain purchase.[3]
3. Ninety percent (90%) or more of leased property fair value is less than the present value of lease payments.[4]
4. Seventy-five percent (75%) or more of asset economic life is committed in lease term.

[3] A written option for bargain purchase is an opportunity for the lessee to buy the asset at less than fair market value at the end of the lease life. This opportunity points to the fact that the asset is substantially owned by the lessee and should be accrued.

[4] The present value is calculated using the lower of the borrower's cost of capital or the implied interest rate on the operating lease (if known).

Because these rules are defined and clear, avoiding the capital lease classification is simple. Frequently, lease contracts will specify the lease life just below seventy-five percent of the asset life. Additionally, they will clearly define the property value, the lease payments, the rate implicit in the lease, and the lessee's incremental borrowing rate. This will allow the lessee to classify the lease as an operating lease.

Operating leases are rental of equipment for a contractual amount of time for a fixed payment. The rental is booked every period as a rent expense and a corresponding payable. This means that the asset being used is expensed through the income statement, and neither this asset nor the corresponding future payments (liability) can be found on the balance sheet. Falling just below the four criteria mentioned above is a simple task, and it exposes a balance sheet to deception, allowing the company to disclose the operating leases only in the notes.

1.6 Lease Disclosure

Companies must state the minimum future rentals on noncancelable leases as of the date of the latest balance sheet presented for each of the succeeding fiscal years. In addition, the aggregate total must also be presented (Financial Accounting Standards Board, 1976). Figure *2* is the contractual obligations footnote of Nike Inc.'s 2013 10-k (Nike, Inc., 2013).

Figure 2

Description of Commitment	Cash Payments Due During the Year Ending May 31,						
(In millions)	2014	2015	2016	2017	2018	Thereafter	Total
Operating Leases	$ 403	$ 340	$ 304	$ 272	$ 225	$ 816	$ 2,360
Capital Leases	23	28	21	9	—	—	81
Long-term Debt	98	46	145	79	56	1,525	1,949
Endorsement Contracts[1]	909	790	586	450	309	559	3,603
Product Purchase Obligations[2]	3,273	—	—	—	—	—	3,273
Other[3]	304	89	52	82	4	18	549
TOTAL	$ 5,010	$ 1,293	$ 1,108	$ 892	$ 594	$ 2,918	$ 11,815

In this study, I examine the commitments that are not accrued on the balance sheet. This number not being presented on the balance sheet will lower the amount of debt on the balance sheet and can improve the ratios used in the Altman Z-score. It will also improve cash flow metrics.

Because companies must disclose all estimable future commitments, some items vary company by company. "Endorsement Contracts" is one commitment that is industry specific that is not considered in this study. The immaterial commitments are grouped together in "other," and this study does not include these commitments because of their unidentifiable source.

"Long-term debt" is the long-term debt obligations for Nike. It is reported at the gross amount of debt coming due and does not include discounts or premiums. This line item is accrued on the balance sheet as a noncurrent liability but the future obligations based on when the debt comes due is reported in the off balance sheet footnote.

"Product purchase obligations" is an item that is estimable and therefore is normally accrued on the balance sheet. These are obligations to transfer funds in the future at fixed or minimum prices. These are commonly seen in take-or-pay or throughput contracts. Because this number is frequently disclosed on the balance sheet, I omit this amount from the off-balance-sheet financing.

The only item frequently found in the commitments footnote that is never accrued on the balance sheet is the operating lease. This is the reason why I chose to only focus on operating leases in this study.

1.7 Growing Use of Leases

Before SFAS No. 13, APB No. 5 was the first to define capital and operating leases in 1964 (American Institute of Certified Public Accountants, 2011). Because Altman's Z-score was built from a sample of firms before 1964, the classification of operating leases between 1964 and 1976 is irrelevant to this study. However, studying this period shows the prevalence of operating leases before SFAS No. 13. In APB No. 5, capital leases were defined as meeting one of the two criteria stated below.

1. The initial term is materially less than the useful life of the property, and the lessee has the option to renew the lease for the remaining useful life of the property at substantially less than the fair value; or
2. The lessee has the right, during or at the expiration of the lease, to acquire the property at a price which at the inception of the lease appears to be substantially less than the probable fair value of the property at the time or times of permitted acquisition by the lessee.

Because of the language of the above rules, companies found it very easy to classify leases as operating leases. When SFAS No. 13 was created, many companies now had to classify prior operating leases as capital leases. This was proven by Sivarama and Moyer in 1984.

After both types of leases began frequently appearing on balance sheets, Sivarama Krishnan and Charles Moyer studied the frequency and impact of these leases in 1984. They found that within eight years of the FASB SFAS No. 13, 20% of firms had capital leases disclosed in their financial statements. Some industries had over 50% of the firms recognizing capital leases just eight years after the standard was issued. The sudden popularity of this type of financing compelled Krishnan and Moyer to analyze how the leases impacted capital structure of the firm and important ratios. They concluded that capital leasing firms and non-capital leasing firms were significantly different in the time period of 1984 to 1986. The capital leasing firms had significantly lower retained earnings relative to total assets, lower coverage ratios, higher operating risk, higher debt ratios, higher growth rates, and lower Altman Z-scores (Sivarama & Charles, 1994). This shows that companies used operating leases to hide debt before 1976 and with SFAS No. 13, a material amount of capital leases became visible on balance sheets.

In 1995, Kirsten Ely identified that operating leases were a way a company can avoid recognizing a liability on the balance sheet. She examined whether the market adjusts equity risk for off-balance sheet financing. The study concluded that there was a relation between equity risk and the effects of operating leases and obligations. She found this relationship through equity risk and the adjustment of the debt-equity ratio for operating leases. So, although operating leases are not included on the balance sheet, investors began adjusting models for significant operating leases. This shows that investors evaluate operating lease asset and liability values when calculating equity risk. This also sheds light on the fact that off-balance-sheet financing is consistent with the concepts underlying the current accounting (Ely, 1995).

1.8 Statement of Purpose

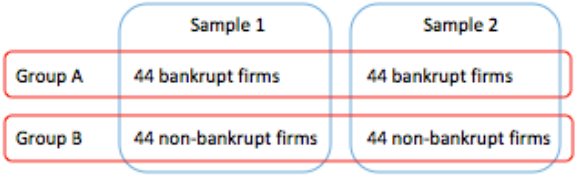
Due to the popularity of operating leases as a form of financing and the evidence that Wall Street adjusts risk models for operating leases, the basis of the study is to adjust current simple bankruptcy models for the added risk of operating leases. To begin, I test the Altman Z-score against a sample of firms to test if the model can be applied to companies that existed 20 years after the model was created. Next, I adjust the Altman Z-score model to reflect the change in economic environment and corporate structure. In doing so, no ratios are changed from the original five that Altman identified as important. This adjustment is so that the later additions to the model can be compared accurately. Lastly, I test multiple additions to the Altman Z-score to determine if the rate of prediction of bankruptcy increases. All of these proposed additions include an operating lease metric.

Chapter 2: Data and Methodology

2.1 Sample Formulation

To develop logistic regression model, a model is built on a sample of firms. In this study, I start with 88 public companies and this group of 88 companies is called sample 1. The model developed is then tested on another sample of firms, called sample 2. Sample 2 is used to test the predictability power of the model. Both groups of 88 firms are split into 44 firms that existed and were listed for all years between 1987 and 1998 (group B) and 44 firms that filed Chapter 7 bankruptcy under the United States Code between 1987 and 1998 (group A). Figure 3 is a diagram of the bankrupt groupings.

Figure 3



All firms used in this study are considered asset-intensive. To determine 'asset-intensive' I rank all industries on the basis of mean plant, property and equipment (PPE) to total assets (AT) ratio. I then construct my samples based on the highest 21 PPE/AT industries to formulate my sample to be large enough. Table 2 shows the frequency of industries used and the PPE/AT ratio of each industry. These frequencies are for both sample 1 and 2 and group A and B.

Table 2

Industry	Total Frequency	% of Population	PPE/AT	Sample 1 Frequency	Sample 2 Frequency
Oil & Gas (Exploration & Production)	44	25%	74%	20 45%	24 55%
Restaurants	33	19%	63%	17 52%	16 48%
Foods	12	7%	41%	7 58%	5 42%
Entertainment	12	7%	41%	8 67%	4 33%
Oil & Gas (Drilling and Equipment)	8	5%	50%	3 38%	5 63%
Airlines	8	5%	42%	4 50%	4 50%
Chemicals (Specialty)	7	4%	42%	4 57%	3 43%
Metals Mining	6	3%	54%	2 33%	4 67%
Air Freight	6	3%	40%	3 50%	3 50%
Water Utilities	6	3%	83%	2 33%	4 67%
Telecommunications (Long Distance)	5	3%	50%	2 40%	3 60%
Health Care (Hospital Management)	5	3%	37%	3 60%	2 40%
Loding-Hotels	4	2%	41%	1 25%	3 75%
Construction (Cement & Aggregates)	4	2%	41%	2 50%	2 50%
Retail (Food Chains)	4	2%	50%	2 50%	2 50%
Paper & Forest Products	3	2%	43%	2 67%	1 33%
Agricultural Products	3	2%	45%	1 33%	2 67%
Gaming, Lottery & Parimutuel Companies	2	1%	40%	2 100%	0 0%
Specialty Printing	2	1%	46%	1 50%	1 50%
Gold & Precious Metal Minings	1	1%	42%	1 100%	0 0%
Truckers	1	1%	58%	1 100%	0 0%
	176	**Total Count**			

Industry	Total Frequency	% of Population	PPE/AT	Group A Frequency	Group B Frequency
Oil & Gas (Exploration & Production)	44	25%	74%	21 48%	23 52%
Restaurants	33	19%	63%	15 45%	18 55%
Foods	12	7%	41%	8 67%	4 33%
Entertainment	12	7%	41%	8 67%	4 33%
Oil & Gas (Drilling and Equipment)	8	5%	50%	4 50%	4 50%
Airlines	8	5%	42%	4 50%	4 50%
Chemicals (Specialty)	7	4%	42%	4 57%	3 43%
Metals Mining	6	3%	54%	2 33%	4 67%
Air Freight	6	3%	40%	2 33%	4 67%
Water Utilities	6	3%	83%	3 50%	3 50%
Telecommunications (Long Distance)	5	3%	50%	3 60%	2 40%
Health Care (Hospital Management)	5	3%	37%	2 40%	3 60%
Loding-Hotels	4	2%	41%	2 50%	2 50%
Construction (Cement & Aggregates)	4	2%	41%	1 25%	3 75%
Retail (Food Chains)	4	2%	50%	4 100%	0 0%
Paper & Forest Products	3	2%	43%	1 33%	2 67%
Agricultural Products	3	2%	45%	2 67%	1 33%
Gaming, Lottery & Parimutuel Companies	2	1%	40%	0 0%	2 100%
Specialty Printing	2	1%	46%	1 50%	1 50%
Gold & Precious Metal Minings	1	1%	42%	1 100%	0 0%
Truckers	1	1%	58%	0 0%	1 100%
	176	**Total Count**			

The descriptive statistics for the sample the Altman Z-score was built on was not disclosed, so I cannot make direct comparisons between my sample and his sample. He classified his sample as only consisting of manufacturing firms. By using only PPE to

AT as a metric of asset-intensive firms, I believe my sample of firms is comparable to the sample of firms he used from 1968.

2.2 Descriptive Sample Statistics

All group B firms existed for all years between 1987 and 1998 and the average of total assets throughout those 11 years was between $5 and $100 million. Because the firms in group B did not file bankruptcy between 1987 and 1998, I choose "last year before bankruptcy" on a random basis. This random selection is made on excel using the "randbetween" function. The actual average of the total assets for group B in the "last year before bankruptcy" was $34 million. The average of the "last year before bankruptcy" was 1991.

All of group A firms existed and were listed in 1987 but bankrupt between 1987 and 1998 and the average of total assets through these years was between $5 and $100 million. The last year before bankruptcy was the last year before the company was de-listed due to chapter 7 bankruptcy. The actual average of the total assets for group A was $40 million. The average of the last year before bankruptcy was 1992.

Table 3 shows summary statistics of the average assets and average year used for bankruptcy for both samples for both group A and group B (in millions of U.S. Dollars).

Table 3

Average Assets

		Sample 1	Sample 2
Group	A	39	42
	B	36	32

Year of Bankruptcy

		Sample 1	Sample 2
Group	A	1992	1993
	B	1991	1991

In this study a matched sample is not used because only 88 asset-intensive firms existed between 1987 and 1998 that meet the criteria to be in this study. In this case, this group of firms (Group B) could not be perfectly matched with a group of asset-intensive firms that filed for bankruptcy between 1987 and 1998. The sample of firms I use had similar averages, which shows that the two groups of data can be compared.

2.3 Original Altman Z-score

Because the Altman Z-score was used as a bankruptcy predictor for decades while remaining unchanged, it was used for this model. Sample 2 tests the accuracy of the Altman Z-score on my selection of firms. Although they are not strictly manufacturing firms, they are PP&E intensive firms. The results of the Altman Z-score test on sample 2 are below in Table 4.

Table 4

Actual	Predicted Non-Bankrupt	Predicted Bankrupt
Group A	22	22
Group B	5	39

	Number Correct	Percent Correct	Percent Error	n
Type I	22	50%	50%	44
Type II	39	89%	11%	44
Total	61	69%	31%	88

Table 4 shows that the Altman Z-score is very accurate at predicting Group B (non-bankrupt) bankruptcy. With a type II error of 11%, the Altman Z-score model can predict bankruptcy for non-bankrupt companies 89% of the time. With a type I error of 50%, the Altman Z-score cannot predict bankruptcy well for bankrupt firms.[5] This could be due to bankrupt companies finding new ways of hiding the factors contributing to their bankruptcy while making their financial statements look healthier.

The cutoff Z-score of 2.675 was used, which was the cutoff determined by Altman when the score was originally created. The cutoff score is the number that predicts bankruptcy. If a company falls below 2.675, the model predicts it will be bankrupt before the next year. If it scores above 2.675, the Z-score predicts it will remain in business. If the cutoff Z-score is raised to 3.00, the prediction rate of the model raises 3%, and this is most likely due to sample differences. If the cutoff score is lowered to 2 the type II error increases and the type I error decreases.

Secondly, the R^2 of Altman's regression on his data sample was 95%. This shows that 95% of the variation in the model is explained by the five ratios in the model. This predictability rate is very high, but when the model is applied to a firm existing over 20 years later, the R^2 is much lower due to the evolution of corporate structure. Because of the difference in time periods, I do not compare the R^2 measurements to future changes in the Altman Z-score.

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[5] A type I error is the incorrect rejection of a true null hypothesis.
A type II error is the failure to reject a false null hypothesis

2.4 Adjusted Altman Z-score

Because the Z-score is being used for a sample of firms existing over 20 years later than the initial sample Altman used, re-weighting the model is necessary. Over the 20 years, classification of liabilities and assets has adjusted. Also, corporate structure evolved so the importance of some of the ratios will have changed.

To re-weight the model, a logistic regression model was used. This is not the same regression used by Altman but it yields the same results. It uses a sum of least squares method to separate the means of each model as far as they can be separated which was the same method that Altman used.

Below in Table 5 are the results of the Altman Z-score adjustment.[6]

Table 5

Parameter	Coefficient	Standard Error	Chi-Square	P Value
X_1	0.134	0.962	0.020	0.889
X_2	0.241	0.247	0.950	0.330
X_3	7.101	2.000	12.601	0.000
X_4	1.183	0.347	11.651	0.001
X_5	-0.369	0.171	4.636	0.031

X_3, X_4, and X_5 describe most of the variation in the dependent variable, bankruptcy. This can be seen by the P values for the variables being the lowest. X_1 and X_2 are statistically insignificant. Although they are insignificant, they can potentially add

[6] All statistical modeling in this study was performed using SAS. Found at http://www.sas.com/en_us/home.html.

predictive power to the model. This is due to overlap between the ratios. For example, X_3 and X_5 might have significant overlap because it is an income metric over total assets. However, X_5 partially explains bankruptcy because EBIT includes profitability instead of just sales. The model weighs X_3 more than X_5, but X_5 still adds predictive power to the model. This marginal addition of predictability power can be described by comparing the adjusted R^2 measurements of the model. The re-weighted Z-score for my sample of firms is below.

$$Z = .134X_1 + .241X_2 + 7.1X_3 + 1.183X_4 - .369X_5$$

The adjusted Z-score model points to the fact that X_5, sales to total assets, has an inverse relationship to bankruptcy. As this ratio increases, the adjusted Z score falls, increasing the chance of a company going bankrupt. This relationship is not further investigated in this research, however I believe this is due to bankrupt companies booking sales in the current period. As a company nears bankruptcy, one bad year of sales will tempt creditors to raise the cost of debt or to force the company into bankruptcy. If the company has a bad year of sales they will adjust estimates to increase these sales. This can easily be done with bad debt expenses, warranties expense, or shipping items just before the year-end. However, a healthy company will not feel as much pressure making these adjustments. With a P value of 0.031, this is a significant relationship and suggests how corporate structure has changed.

2.5 Testing the Adjusted Altman Z-score

Model fit statistics are shown in Table 6 below.[7]

Table 6

	Chi-Suare	DF	Significance
Likelihood Ratio	49.725	5	<.0001
Score	27.524	5	<.0001
Wald	18.959	5	0.002
R-square	0.519		
Adj R-Sq	0.490		

The R^2 of the model shows the amount of variation in the dependent variable (bankruptcy) is explained by the five dependent variables in the model ($\frac{WC}{TA}, \frac{RE}{TA}, \frac{EBIT}{TA}, \frac{MVE}{BVD}, \frac{SALES}{TA}$). This model explains 51.9% of the variation. The adjusted R^2 is adjusted for the degrees of freedom in the model. This is the number that can be compared between models that have different degrees of freedom. Because of time period the Altman Z-score was built on, this adjusted R^2 number cannot be compared to the R^2 Altman's model could prove with his sample. To compare these two models I use combined error found in Table 7.

With the re-weighted Z-score, the same bankruptcy test was run on sample 2, not the same data on which the model was built (sample 1). Table 7 below shows the results of the re-weighted Z-score.

[7] All descriptive statistics for the Adjusted Altman Z-score produced by SAS can be found in Appendix II.

Table 7

	Predicted	
Actual	Group A	Group B
Group A	38	6
Group B	8	36

	Number Correct	Percent Correct	Percent Error	n
Type I	38	86%	14%	44
Type II	36	82%	18%	44
Total	74	84%	16%	88

The new model has more type II error but it drastically reduces the type I error. In total, the model can predict 84% of the bankruptcies a year before they occur. The Altman Z-score model can predict only 69% of the bankruptcies for my sample and thus is inaccurate in predicting if existing companies will exist in a year (type I error). The adjusted Z-score ratio is next compared to Z-scores including operating lease data. The cutoff score used to maximize the prediction rate is -0.2.

2.6 Proposed Additions

The two operating lease variables that could add predictability power to the model are below:

$$X_6 = \frac{Operating\ Leases}{Total\ Assets}$$

$$X_7 = \frac{Operating\ Leases}{Total\ Liabilities}$$

X_6 - Discounted Operating Leases/Total Assets. This metric takes operating leases and scales it to the size of the firm. As the firm approaches bankruptcy, the size of the firm will stay the same while the company will be pushing debt off the balance sheet in the form of operating leases. This variable cannot differentiate between new firms and old firms.

X_7 - Discounted Operating Leases/Total Liabilities. Operating leases compared to total liabilities compares the amount of operating leases the company has to the amount of debt. This variable will be more sensitive to debt movement but fails to analyze company size.

When calculating 'discounted operating leases', using the aggregate total would assume that a one-dollar liability due next year is equivalent to a one-dollar liability due in 5 years. This is why discounting the operating leases is necessary. A typical discount rate used for debt is the cost of debt. This was assumed to be 14% in this study. Because both samples are discounted with the same rate, the discount rate in this study should not affect results. Below is the equation used to determine discounted operating leases. It is a simple discount formula repeated for each year.

$$Total\ Discounted\ Operating\ Leases = \frac{Year\ 1}{(1+i)^1} + \frac{Year\ 2}{(1+i)^2} + \frac{Year\ 3}{(1+i)^3} + \frac{Year\ 4}{(1+i)^4} + \frac{Year\ 5}{(1+i)^5}$$
$$i = interest\ rate\ assumed$$

Year 5 includes the 'thereafter' portion of the operating leases. Because companies do not specify when the 'thereafter' leases are due, it was assumed they were in year 5 for simplicity. The 'thereafter' portion of the operating lease was normally an insignificant number, so discounting it by five years was appropriate.

From a quick analysis, X_6 increases as the firm approaches bankruptcy. However, X_7 decreases as a firm approaches bankruptcy. This points to the fact that as a firm approaches bankruptcy, total liabilities grow faster than off-balance-sheet financing. However, more analysis is needed to determine if this is the true relationship.

To test the individual discriminating ability of the variables, an "F" test is performed. This test relates the difference between the average values of the ratios in each group to the spread of values within each group. These ratios are all from one financial statement prior to bankruptcy. The resulting "F" statistics are presented in Table 8.

Table 8

Variable Means and Significance Test

Variable	Bankrupt Group Mean	Non-Bankrupt Group Mean	Chi Sq.	P value
X_6	23.80%	17.30%	6.863	0.009
X_7	29.80%	42.20%	4.775	0.029
	n=44	n=44		

The means for both ratios are significantly different, as seen by the P value being less than 0.05. The X_6 P value is lower, showing that it has more significance in the model. However, due to possible "overlap" with the other ratios, the addition of these metrics were not necessarily increase the predictability power of the model.

2.7 X_6 and X_7 Added to the Z-score

The first addition to the Z-score is X_6, discounted operating leases over total assets. The analysis and significance are shown in Table 9 below.[8]

[8] All descriptive statistics for the Adjusted Altman Z-score produced by SAS can be found in Appendix III.

Table 9

Parameter	Coefficient	Standard Error	Chi-Square	P Value
X_1	0.043	0.987	0.002	0.965
X_2	0.266	0.256	1.084	0.298
X_3	7.026	2.003	12.303	0.001
X_4	1.221	0.358	11.635	0.001
X_5	-0.310	0.200	2.403	0.121
X_6	-0.687	1.247	0.304	0.582

	Chi-Square	DF	P Value
Likelihood Ratio	50.026	6	<.001
Score	27.524	6	<.001
Wald	18.599	6	0.006

R-square	0.523
Adj R-Sq	0.488

X_6 has a P value of 0.582, showing that it is not significant. However, it can still add predictability power to the model. The P value of X_5 became insignificant in this model, showing that there is overlap between X_5 and X_6.

The second addition to the Z-score is X_7, discounted operating leases over total liabilities. From a univariate standpoint, X_6 has more predictive power than X_7 but comparing adjusted models illustrates whether overlap exists between the variables. The results of the addition of X_7 are in Table 10 below.[9]

[9] All descriptive statistics for the Adjusted Altman Z-score produced by SAS can be found in Appendix IV.

Table 10

Parameter	Coefficient	Standard Error	Chi-Square	P Value
X_1	0.112	0.972	0.013	0.908
X_2	0.255	0.256	0.987	0.320
X_3	7.109	2.003	12.600	0.000
X_4	1.209	0.367	10.861	0.001
X_5	-0.352	0.185	3.616	0.057
X_7	-0.149	0.627	0.056	0.812

	Chi-Square	DF	P Value
Likelihood Ratio	49.779	6	<.001
Score	27.886	6	<.001
Wald	18.864	6	0.004

R-square	0.524
Adj R-Sq	0.489

X_7 has a P value of 0.812, showing that it is not a significant addition to the model. However, it can still add predictability power to the model. The only way to test the addition of predictability power is to compare adjusted R^2 to see whether X_6 or X_7 is a better predictor of bankruptcy. Lastly, X_7's coefficient is negative, as predicted earlier in the study. This is due to the liabilities growing at a faster rate than discounted operating leases.

2.8 X_6 and X_7 Comparison

Summary statistics from the models can be found in Table 11 below.

Table 11

Model	R2	Adjusted R2
X6	52.27%	48.78%
X7	52.40%	48.92%

Because the adjusted R^2 is highest for the model with the addition of X_7, X_7 is a better predictor of bankruptcy. Although the F ratio is higher and the P value was more significant, the model with X_6 is less accurate due to overlap with over variables. Because of this, X_7 is a better predictor of bankruptcy than X_6. The model with X_7 is written below.

$$Z = 0.112X_1 + 0.255X_2 + 7.109X_3 + 1.209X_4 - 0.352X_5 - 0.149X_7$$

2.9 Comparing X_7 and the Adjusted Altman

Testing the addition of X_7 on sample 2 was done below in

Table 12.

Table 12

	Predicted	
Actual	Non-Bankrupt	Bankrupt
Group A	38	6
Group B	10	34

	Number Correct	Percent Correct	Percent Error	n
Type I	38	86%	14%	44
Type II	34	77%	23%	44
Total	72	82%	18%	88

For this Z-score, the cutoff score before a firm was predicted as bankrupt was -0.25. The model accurately classifies 82% of the total sample correctly. The type I error proved to be 14% while the type II error proved to be 23%. The results show that the addition of X_7 provides no improvements to the adjusted Z-score model as seen in Table 7. The slight difference is most likely due to sample differences. The results of this comparison show that for both sets of 88 bankrupt and non-bankrupt firms, the Z-score with X_7 is not more accurate at predicting bankruptcy than the adjusted Altman Z-score.

Furthermore, Table 13 shows that although similar, the adjusted R^2 for the adjusted Altman model is higher than the model with X_7.

Table 13

Model	R^2	Adjusted R^2
Adjusted Altman	51.89%	48.99%
X7	52.40%	48.92%

Conclusion

This paper seeks to analyze the relationship between operating leases and bankruptcy. Since the creation of the Altman Z-score model in 1968, the Z-score has been the industry standard to predict bankruptcy. However, as corporations evolved and new accounting standards changed the industry, the Altman Z-score became outdated and the old ratios did not hold the same significance. Using a sample of asset intensive companies, the Altman Z-score only predicts 69% (Table 4) of the bankruptcy one year before bankruptcy. Using a different sample of companies from the same period, I adjust the Altman Z-score to reflect current corporate structure. This 'adjusted Altman Z-score' provided a significant improvement from the original Altman Z-score. The adjusted score was able to predict over 84% (Table 7) of the bankruptcies one year before they occurred. A limitation of this study is that due to a specific set of criteria that the sample must meet, a matched sample could not be used. The two samples are similar in asset size and asset-intensiveness.

This adjustment to the Z-score does not change the ratios included in the original Altman Z-score, it only affects the coefficients of the ratios. As corporate structure and the business environment changes, the weights to each ratio, or coefficients, change also. This adjustment fails to include any new classifications in the financial statements that were created after 1968. One important additional classification has been operating leases. I attest whether the addition of operating leases improves the Altman Z-score model. The results show that the addition of operating leases does not improve the

predictability power of the Altman Z-score. In future studies, newer classifications of assets and liabilities can be tested, such as the use of Special Purpose Entities (SPE's).

The practical application of this study is for an average investor evaluating equity and bankruptcy risk. It is the same model as the frequently used Altman Z-score but the adjusted Altman Z-score is for firms with a PPE/AT ratio of over 40% and with asset size of 5 to 100 million U.S. dollars. This will allow an investor to confidently pick safe investments and value equity effectively. It is important to note that this adjusted Altman Z-score has no international application under IFRS as all assumptions are built on GAAP standards.

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APPENDICES

Appendix 1

NIKE, Inc. Consolidated Balance Sheets

(In millions)	May 31, 2013	2012
ASSETS		
Current assets:		
Cash and equivalents	$ 3,337	$ 2,317
Short-term investments (Note 6)	2,628	1,440
Accounts receivable, net (Note 1)	3,117	3,132
Inventories (Notes 1 and 2)	3,434	3,222
Deferred income taxes (Note 9)	308	262
Prepaid expenses and other current assets (Notes 6 and 17)	802	857
Assets of discontinued operations (Note 15)	–	615
Total current assets	13,626	11,845
Property, plant and equipment, net (Note 3)	2,452	2,209
Identifiable intangible assets, net (Note 4)	382	370
Goodwill (Note 4)	131	131
Deferred income taxes and other assets (Notes 6, 9 and 17)	993	910
TOTAL ASSETS	**$ 17,584**	**$ 15,465**
LIABILITIES AND SHAREHOLDERS' EQUITY		
Current liabilities:		
Current portion of long-term debt (Note 8)	$ 57	$ 49
Notes payable (Note 7)	121	108
Accounts payable (Note 7)	1,646	1,549
Accrued liabilities (Notes 5, 6 and 17)	1,986	1,941
Income taxes payable (Note 9)	98	65
Liabilities of discontinued operations (Note 15)	18	170
Total current liabilities	3,926	3,882
Long-term debt (Note 8)	1,210	228
Deferred income taxes and other liabilities (Notes 6, 9 and 17)	1,292	974
Commitments and contingencies (Note 16)	–	–
Redeemable Preferred Stock (Note 10)	–	–
Shareholders' equity:		
Common stock at stated value (Note 11):		
Class A convertible — 178 and 180 shares outstanding	–	–
Class B — 716 and 736 shares outstanding	3	3
Capital in excess of stated value	5,184	4,641
Accumulated other comprehensive income (Note 14)	274	149
Retained earnings	5,695	5,588
Total shareholders' equity	11,156	10,381
TOTAL LIABILITIES AND SHAREHOLDERS' EQUITY	**$ 17,584**	**$ 15,465**

The accompanying notes to consolidated financial statements are an integral part of this statement.

NIKE, Inc. Consolidated Statements Of Income

(In millions, except per share data)	Year Ended May 31, 2013	2012	2011
Income from continuing operations:			
Revenues	$ 25,313	$ 23,331	$ 20,117
Cost of sales	14,279	13,183	10,915
Gross profit	11,034	10,148	9,202
Demand creation expense	2,745	2,607	2,344
Operating overhead expense	5,035	4,458	4,017
Total selling and administrative expense	7,780	7,065	6,361
Interest (income) expense, net (Notes 6, 7 and 8)	(3)	4	4
Other (income) expense, net (Note 17)	(15)	54	(25)
Income before income taxes	3,272	3,025	2,862
Income tax expense (Note 9)	808	756	690
NET INCOME FROM CONTINUING OPERATIONS	**2,464**	**2,269**	**2,172**
NET INCOME (LOSS) FROM DISCONTINUED OPERATIONS	**21**	**(46)**	**(39)**
NET INCOME	**$ 2,485**	**$ 2,223**	**$ 2,133**
Earnings per share from continuing operations:			
Basic earnings per common share (Notes 1 and 12)	$ 2.75	$ 2.47	$ 2.28
Diluted earnings per common share (Notes 1 and 12)	$ 2.69	$ 2.42	$ 2.24
Earnings per share from discontinued operations:			
Basic earnings per common share (Notes 1 and 12)	$ 0.02	$ (0.05)	$ (0.04)
Diluted earnings per common share (Notes 1 and 12)	$ 0.02	$ (0.05)	$ (0.04)
Dividends declared per common share	$ 0.81	$ 0.70	$ 0.60

The accompanying notes to consolidated financial statements are an integral part of this statement.

Appendix 2

The SAS System

The LOGISTIC Procedure

Model Information	
Data Set	WORK.SAMPLE1
Response Variable	BKRPT
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	88
Number of Observations Used	88

Response Profile		
Ordered Value	BKRPT	Total Frequency
1	1	44
2	0	44

Probability modeled is BKRPT='1'.

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	Without Covariates	With Covariates
AIC	121.994	82.269
SC	121.994	94.656
-2 Log L	121.994	72.269

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	49.7248	5	<.0001
Score	27.5243	5	<.0001
Wald	18.9588	5	0.0020

Analysis of Maximum Likelihood Estimates					
Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
WC	1	0.1344	0.9618	0.0195	0.8888
RE	1	0.2408	0.2470	0.9504	0.3296
EBIT	1	7.1009	2.0004	12.6009	0.0004
MCAP	1	1.1830	0.3466	11.6507	0.0006
REV	1	-0.3685	0.1711	4.6363	0.0313

Odds Ratio Estimates			
Effect	Point Estimate	95% Wald Confidence Limits	
WC	1.144	0.174	7.535
RE	1.272	0.784	2.065
EBIT	>999.999	24.052	>999.999
MCAP	3.264	1.655	6.438
REV	0.692	0.495	0.967

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	89.0	Somers' D	0.781
Percent Discordant	11.0	Gamma	0.781
Percent Tied	0.0	Tau-a	0.395
Pairs	1936	c	0.890

The SAS System

The REG Procedure
Model: MODEL1
Dependent Variable: BKRPT

Number of Observations Read	88
Number of Observations Used	88

Note: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	22.83035	4.56607	17.90	<.0001
Error	83	21.16965	0.25506		
Uncorrected Total	88	44.00000			

Root MSE	0.50503	R-Square	0.5189
Dependent Mean	0.50000	Adj R-Sq	0.4899
Coeff Var	101.00615		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
WC	1	0.12739	0.16199	0.79	0.4339
RE	1	-0.01269	0.03730	-0.34	0.7346
EBIT	1	0.67724	0.22667	2.99	0.0037
MCAP	1	0.08281	0.01652	5.01	<.0001
REV	1	0.14774	0.02874	5.14	<.0001

Appendix 3

The SAS System

The LOGISTIC Procedure

Model Information	
Data Set	WORK.SAMPLE1
Response Variable	BKRPT
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	88
Number of Observations Used	88

Response Profile		
Ordered Value	BKRPT	Total Frequency
1	1	44
2	0	44

Probability modeled is BKRPT='1'.

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	Without Covariates	With Covariates
AIC	121.994	83.968
SC	121.994	98.832
-2 Log L	121.994	71.968

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	50.0258	6	<.0001
Score	27.5244	6	0.0001
Wald	18.5993	6	0.0049

Analysis of Maximum Likelihood Estimates					
Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
WC	1	0.0428	0.9870	0.0019	0.9654
RE	1	0.2664	0.2559	1.0838	0.2978
EBIT	1	7.0260	2.0031	12.3033	0.0005
MCAP	1	1.2206	0.3578	11.6353	0.0006
REV	1	-0.3102	0.2001	2.4027	0.1211
MRCT	1	-0.6873	1.2474	0.3036	0.5816

Odds Ratio Estimates			
Effect	Point Estimate	95% Wald Confidence Limits	
WC	1.044	0.151	7.222
RE	1.305	0.790	2.155
EBIT	>999.999	22.199	>999.999
MCAP	3.389	1.681	6.834
REV	0.733	0.495	1.085
MRCT	0.503	0.044	5.799

The SAS System

The REG Procedure
Model: MODEL1
Dependent Variable: BKRPT

Number of Observations Read	88
Number of Observations Used	88

Note: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	23.00038	3.83340	14.97	<.0001
Error	82	20.99962	0.25609		
Uncorrected Total	88	44.00000			

Root MSE	0.50606	R-Square	0.5227
Dependent Mean	0.50000	Adj R-Sq	0.4878
Coeff Var	101.21126		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
WC	1	0.15288	0.16531	0.92	0.3578
RE	1	-0.01551	0.03754	-0.41	0.6805
EBIT	1	0.70072	0.22895	3.06	0.0030
MCAP	1	0.08207	0.01658	4.95	<.0001
REV	1	0.12939	0.03656	3.54	0.0007
MRCT	1	0.17380	0.21330	0.81	0.4175

Appendix 4

The SAS System

The LOGISTIC Procedure

Model Information	
Data Set	WORK.SAMPLE1
Response Variable	BKRPT
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	88
Number of Observations Used	88

Response Profile		
Ordered Value	BKRPT	Total Frequency
1	1	44
2	0	44

Probability modeled is BKRPT='1'.

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	Without Covariates	With Covariates
AIC	121.994	84.215
SC	121.994	99.079
-2 Log L	121.994	72.215

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	49.7787	6	<.0001
Score	27.8856	6	<.0001
Wald	18.8642	6	0.0044

Analysis of Maximum Likelihood Estimates					
Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
WC	1	0.1124	0.9716	0.0134	0.9079
RE	1	0.2546	0.2562	0.9871	0.3204
EBIT	1	7.1091	2.0027	12.6001	0.0004
MCAP	1	1.2089	0.3668	10.8605	0.0010
REV	1	-0.3518	0.1850	3.6156	0.0572
MRCT2	1	-0.1489	0.6272	0.0564	0.8123

Odds Ratio Estimates			
Effect	Point Estimate	95% Wald Confidence Limits	
WC	1.119	0.167	7.514
RE	1.290	0.781	2.131
EBIT	>999.999	24.138	>999.999
MCAP	3.350	1.632	6.875
REV	0.703	0.489	1.011
MRCT2	0.862	0.252	2.946

The SAS System

The REG Procedure
Model: MODEL1
Dependent Variable: BKRPT

Number of Observations Read	88
Number of Observations Used	88

Note: No intercept in model. R-Square is redefined.

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	23.05801	3.84300	15.05	<.0001
Error	82	20.94199	0.25539		
Uncorrected Total	88	44.00000			

Root MSE	0.50536	R-Square	0.5240
Dependent Mean	0.50000	Adj R-Sq	0.4892
Coeff Var	101.07227		

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
WC	1	0.14221	0.16286	0.87	0.3851
RE	1	-0.01725	0.03764	-0.46	0.6480
EBIT	1	0.67926	0.22683	2.99	0.0036
MCAP	1	0.07899	0.01702	4.64	<.0001
REV	1	0.13355	0.03245	4.12	<.0001
MRCT2	1	0.08380	0.08876	0.94	0.3479